• 15V0102B1TECO •

# SINUS PENTA

MULTIFUNCTION AC DRIVE

# BASIC
# USER MANUAL

Issued on 09/11/11
R. 04


• This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
• This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
• TECO Electric & Machinery Co., Ltd. is responsible for the device in its original setting.
• Any changes to the structure or operating cycle of the device must be performed or authorized by the Engineering Department of TECO Electric & Machinery Co., Ltd.
• TECO Electric & Machinery Co., Ltd. assumes no responsibility for the consequences resulting by the use of non-original spare-parts.
• TECO Electric & Machinery Co., Ltd. reserves the right to make any technical changes to this manual and to the device without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.
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# 0. STARTUP

NOTE

This manual covers basic installations of the Penta drive. For more details, please refer to the standard Sinus Penta's **Installation Instructions** manual.

NOTE

SINUS PENTA drives are factory set with the IFD control algorithm (V/f) allowing performing the first startup of the equipment. The default functions are given in this section, particularly in step **5) Start up**.

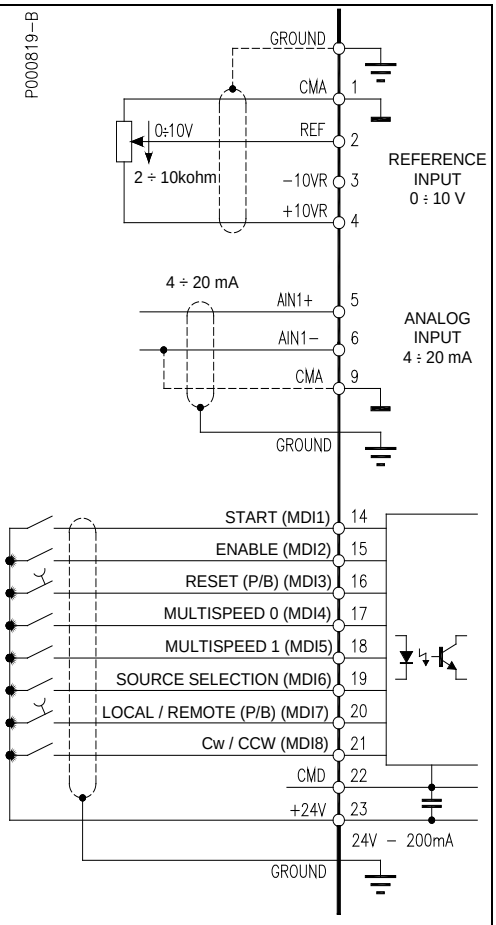
| | |
|---|---|
| **1) Inspection:** | Check if the size of the Penta drive is greater than or equal to the size of the connected motor according to the drive nameplate. See the Delivery Check section. |
| **2) Installation and wiring:** | The IP rating of the Penta drive is given in the Installing the Equipment section. Ensure that sufficient ventilation is provided to the drive. More details are given in the standard Sinus Penta's **Installation Instructions** manual. |
| **3) Power on:** | Power on the drive; check if the keypad turns on. |
| **4) Parameter setting:** | For an easier startup of the Penta drive, you can activate the Start-Up Menu. The Start-Up Menu is a wizard allowing programming the main parameters for the connected motor.<br>The Start-Up Menu is displayed when the Penta drive is first started. The Start-Up Menu can be reactivated at any time. To do so, set **P265** in "Start Up" mode:<br>`[IDP]SINUS PENTA`<br>`START-UP MENU`<br>`Press ENTER`<br>`to start`<br>Press Enter to enter the wizard.<br>Before entering the control parameters, you are asked to choose a dialogue language:<br>`P263 Language`<br>`→@@@@@@@@@@@@@@@@`<br>Then you are asked to choose the display mode of the Start Up Menu:<br>`When does the`<br>`Start-Up Menu`<br>`activate?`<br>`→@@@@@@@@@@@@@@@@`<br>Choose one of the following:<br>`1:EVERY START-UP`<br>`2:ONLY NOW`<br>`3:NEXT START-UP`<br>`4:NEVER` |

If you select "EVERY START–UP", the wizard appears whenever the Penta drive is powered on;
if you select "ONLY NOW", you can scroll through the menu and the wizard is disabled as soon as you quit the menu;
if you select "NEXT START–UP", the menu is displayed only when the Penta drive is next started up;
if you select "NEVER", the Start-Up menu is disabled.

Parameters included in the Start-Up menu:

| Parameter | Description | Visibility |
|---|---|---|
| C008 | Rated mains voltage | |
| C010 | Type of control algorithm | |
| C012 | Speed feedback from encoder | [only if FOC is active] |
| C013 | Type of V/f pattern | [only if IFD is active] |
| C015 | Rated motor frequency | |
| C016 | Rated motor rpm | |
| C017 | Rated motor power | |
| C018 | Rated motor current | |
| C019 | Rated motor voltage | |
| C021 | No-load current of the motor | [only if FOC is active] |
| C028 | Min. motor speed | |
| C029 | Max. motor speed | |
| C034 | Voltage preboost | [only if IFD is active] |
| P009 | Acceleration ramp time | |
| P010 | Deceleration ramp time | |
| C043 | Current limit while accelerating | [only if IFD is active] |
| C044 | Current limit at constant rpm | [only if IFD is active] |
| C045 | Current limit while decelerating | [only if IFD is active] |
| C048 | Torque limit | [only if VTC/FOC are active] |
| C189 | Encoder operating mode | [only if FOC is active] |
| C190 | Encoder A pls/rev | [only if FOC is active] |
| C191 | Encoder B pls/rev | [only if FOC is active] |
| I073 | Autotuning selection | [only if VTC/FOC are active] |
| I074 | Motor tuning selection | [only if VTC/FOC are active] |
| C265 | Motor thermal protection | |
| C267 | Motor thermal time constant | [only if protection is active] |

| | |
|---|---|
| | After setting the last parameter and moving the cursor forward, the following page will appear:<br><br>`Press UP ARROW`<br>`to quit`<br>`DOWN ARROW`<br>`to continue`<br><br>Press ▲ to quit the Start-up menu. The default page of the system will be displayed. |

| | |
|---|---|
| **5) Startup:** | **Terminal Control:**<br>i) Activate the **ENABLE** input (terminal 15).<br>ii) Activate the **START** input (terminal 14).<br>iii) Send speed reference to REF: 0-10V (terminals 1, 2 & 3)<br>or<br>Send speed reference to AIN1: 4-20mA (terminals 5 & 6). This requires Source Selection input on MDI6 to be active (terminal 19).<br>The RUN LED and REF LED will be lit and the motor will start. Make sure that the motor is rotating in the correct direction.<br>If not, operate on terminal MDI5 (terminal 18) (CW/CCW) or open the **ENABLE** and **START** terminals. Shut off the drive, wait at least 20 minutes and swap two of the motor phases.<br>**Keypad Control:**<br>i) Activate the **ENABLE** input (terminal 15).<br>ii) Press the **LOCAL/REMOTE** button on the keypad.<br>iii) The L-CMD and L-REF LEDs will be lit.<br>iv) Press the **START** button.<br>v) Hold the Up button to increase the speed reference.<br>The RUN LED and REF LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction.<br>If not, press the **FWD/REV** button or press **STOP**. Shut off the drive, wait at least 20 minutes and swap two of the motor phases.<br>  |
| **6) Possible failures:** | If no failure occurred, go to the next step. Otherwise, check the drive connections paying particular attention to supply voltages, DC link and input reference.<br>Also check if alarm messages are displayed. In the MEASURES MENU, check values in the Fault List for the reference speed (**M000**), the supply voltage to the drive (**M030**), the DC link voltage (**M029**), and the condition of control terminals (**M033**). Check to see if these readouts match with the measured values. |
| **7) Additional parameter alterations:** | In **BASIC** user level, adjustments can be made to a limited number of parameters. The SINUS PENTA has a wide range of functions; to access these function, set the user level to **ADVANCED** or **ENGINEERING** by adjusting parameter **P001** accordingly (refer to Sinus Penta's Programming Instructions manual). |
| **8) Reset:** | If an alarm trips, find the cause responsible for the alarm and reset the equipment. Enable MDI3 (terminal 16) or press the **RESET** key on the display/keypad. |

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## 1.4. How to Use this Manual

### 1.4.1. OVERVIEW

This User Manual (Basic User Manual) provides information required to setup and monitor the drives of the Sinus Penta series manufactured by TECO when used in the Basic mode.

The section concerning the hardware description and installation covers basic wiring only. Refer to the **Installation Instructions** manual to install additional options and/or to configure analogue/digital inputs and outputs.

The Sinus Penta is delivered in Basic mode, which provides a cut down parameter set and preset I/O settings. If additional adjustment is required, this may be achieved by setting the drive to Advanced or Engineering using parameter **P001** (see the PASSWORD AND USER LEVEL MENU in the **Programming Instructions** manual.

Setup/monitoring may be obtained using one or both of the following options:

1) Display/keypad unit;
2) Serial link through RS485 standard port or ES822 optional board.

For the instructions on how to use and remote the display/keypad unit, please refer to the **Installation Instructions** manual.

Any information sent to/from the drive through the display/keypad unit may be obtained also via serial link using the RemoteDrive software application provided by TECO.

The RemoteDrive allows the following functions: image acquisition, keypad simulation, oscilloscope functions and multifunction tester, table compiler including operation data log, parameter setup and data reception-transmission-storage from and to a calculator, scan function for the automatic detection of the connected drives (up to 247 drives may be connected).

When used in Advanced or Engineering mode, many additional functions are available. These include the following:

- Customisation of Keypad navigation.
- Customisation of standard monitoring values.
- Selection of up to 4 acceleration and deceleration ramps.
- Customisation and scaling of analog input signals.
- Selection of up to 15 preset speeds.
- Configuration of 3 prohibit speeds.
- Utilisation of a speed variation function.
- Tuning of VTC and FOC algorithms.
- Customisation of analog output signals.
- Allocation of internal timer functions to digital I/O.
- PID activation and tuning.
- Configuration of Digital output comparator and logic functions.
- Master/slave operation with torque control.
- Adjustment of current and torque limits.
- Customisation of digital inputs.
- Setting of control source for start and speed commands.
- Configuration of a connected encoder.
- DC braking.
- Dynamic braking.
- Speed Search function.
- Autoreset.
- Motor thermal modelling and thermistor allocation.
- Crane control functions.
- Serial and Fieldbus communication.

If any of the above functions is required, use parameter **P001** to access the Advanced or Engineering settings.

# 2. HARDWARE DESCRIPTION AND INSTALLATION

## 2.1. Caution Statements

SYMBOLS:

DANGER — Indicates operating procedures that, if not correctly performed, may cause serious injury or death due to electrical shock.

CAUTION — Indicates operating procedures that, if not carried out, may cause serious equipment failure.

NOTE — Indicates important hints concerning the equipment operation.

SAFETY STATEMENTS TO FOLLOW WHEN INSTALLING AND OPERATING THE EQUIPMENT:

NOTE

1. Always read this instruction manual before starting the equipment.
2. The ground connection of the motor casing should follow a separate path to avoid possible interferences.

DANGER

1. ALWAYS PROVIDE PROPER GROUNDING OF THE MOTOR CASING AND THE DRIVE FRAME.
2. If a differential relay against electric shocks is intended to be used, this must be a "B-type" differential relay.
3. The drive may generate an output frequency up to 1000 Hz; this may cause a motor rotation speed up to 20 (twenty) times the rated motor speed (for 50Hz motors): never use the motor at higher speed than the max. allowable speed stated on the motor nameplate.
4. ELECTRICAL SHOCK HAZARD – Never touch the drive electrical parts when the drive is on; always wait at least 20 minutes after switching off the drive before operating on the drive.
5. Never perform any operation on the motor when the drive is on.
6. Do not perform electrical connections on the motor or the drive if the drive is on. Electrical shock hazard exists on output terminals (U,V,W) and resistive braking module terminals (+, –, B) even when the drive is disabled. Wait at least 20 minutes after switching off the drive before operating on the electrical connection of the motor or the drive.
7. MECHANICAL MOTION – The drive determines mechanical motion. It is the operator's responsibility to ensure that this does not give rise to any dangerous situation.
8. EXPLOSION AND FIRE – Explosion and fire hazard exists if the equipment is installed in presence of flammable fumes. Do not install the drive in places exposed to explosion and fire hazard, even if the motor is installed there.

CAUTION

1. Do not connect supply voltages exceeding the equipment rated voltage to avoid damaging the internal circuits.
2. If the drive is installed in environments exposed to flammable and/or explosive substances (AD zones according to IEC 64-2 standards), please refer to IEC 64-2, EN 60079-10 and related standards.
3. Do not connect the equipment power supply to the output terminals (U,V,W), to the resistive braking module terminals (+, -, B) or to the control terminals. The equipment power supply must be connected only to terminals R,S,T.
4. Do not short-circuit terminals (+) and (-) and terminals (+) and (B); do not connect any braking resistors with lower ratings than the required ratings given in the **Installation Instructions** manual.
5. Do not start or stop the connected motor using a contactor over the inverter power supply.
6. Do not install any contactor between the inverter and the motor. Do not connect any power factor correction capacitor to the motor.
7. Operate the inverter only if a proper grounding is provided.
8. If an alarm trips, a comprehensive review of the ALARMS AND WARNINGS section is recommended; restart the equipment only after removing the cause responsible for the alarm trip.
9. Do not perform any insulation test between the power terminals or the control terminals.
10. Make sure that the fastening screws of the control terminal board and the power terminal board are properly tightened.
11. Do not connect single-phase motors.
12. Always use a motor thermal protection (use the inverter motor thermal model or a thermoswitch installed in the motor).
13. Respect the environmental requirements for the equipment installation.
14. The bearing surface of the drive must be capable of withstanding high temperatures (up to 90°C).
15. The drive electronic boards contain components which may be affected by electrostatic discharges. Do not touch them unless it is strictly necessary. Always be very careful so as to prevent any damage caused by electrostatic discharges.

ATTENTION
Static Sensitive Devices.
Handle Only at Static Safe Work Stations.
ATTENTION
Circuits sensibles à l´électricité statique.
Manipulation uniquement autorisée sur un poste de travail protégé.
ACHTUNG
Elektrostatisch gefährdete Bauelemente.
Handhabung daher nur an geschützten Arbeitsplätzen erlaubt.

## 2.2. Delivery Check

Make sure that the equipment is not damaged and that it complies with the equipment you ordered by referring to the nameplate located on the drive front part. The drive nameplate is described below. If the equipment is damaged, contact the supplier or the insurance company concerned. If the equipment does not comply with the one you ordered, please contact the supplier as soon as possible.
If the equipment is stored before being started, make sure that the ambient conditions do not exceed the ratings mentioned in the Installing the Equipment section. The equipment guarantee covers any manufacturing defect. The manufacturer has no responsibility for possible damages occurred when shipping or unpacking the drive. The manufacturer is not responsible for possible damages or faults caused by improper and irrational uses; wrong installation; improper conditions of temperature, humidity, or the use of corrosive substances. The manufacturer is not responsible for possible faults due to the drive operation at values exceeding the drive ratings and is not responsible for consequential and accidental damages. The equipment is covered by a 3-year guarantee starting from the date of delivery.

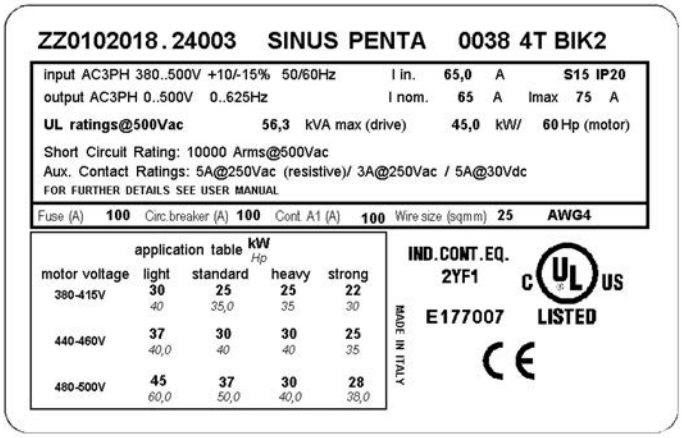
Product ID:

| SINUS | PENTA | 0005 | 4 | T | B | A2 | X | 2 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | |
|---|---|
| 1 | Product line:<br>SINUS stand-alone inverter<br>SINUS BOX inverter contained inside a box<br>SINUS CABINET inverter contained inside a cabinet |
| 2 | PENTA control |
| 3 | Inverter Model |
| 4 | Supply voltage<br>2 = Power supply 200÷240VAC; 280÷340VDC<br>4 = Power supply 380÷500VAC; 530÷705VDC<br>5 = Power supply 500÷600VAC, 705÷845VDC<br>6 = Power supply 600÷690VAC; 845÷970VDC |
| 5 | Type of power supply<br>T = three-phase<br>C=direct current<br>D = 12-pulse bridge (12-phase) |
| 6 | Braking module<br>X = no internal braking chopper<br>B = built-in braking chopper |
| 7 | Type of EMC filter:<br>I = no filter provided;<br>A1 = integrated filter, EN 61800-3 issue 2 FIRST ENVIRONMENT Category C2, EN55011 gr.1 cl. A for industrial and domestic users.<br>A2 = integrated filter, EN 61800-3 issue 2 SECOND ENVIRONMENT Category C3, EN55011 gr.2 cl. A for industrial users.<br>B = integrated input filter (type A1) plus external, output toroid filter, EN 61800-3 issue 2 FIRST ENVIRONMENT Category C1, EN55011 gr.1 cl. B for industrial and domestic users. |
| 8 | Control panel<br>X = no control panel provided (display/keypad)<br>K = control panel and back-lit, 16 x 4 character LCD display provided. |
| 9 | Degree of protection<br>0 = IP00 (Sizes greater than S32)<br>2 = IP20 (up to Size S32)<br>5 = IP54 (possible up to Size S32) |

### 2.2.1. NAMEPLATE

Typical nameplate for 4T SINUS PENTA Drives:


ZZ0102018.24003 SINUS PENTA 0038 4T BIK2
input AC3PH 380..500V +10/-15% 50/60Hz I in. 65,0 A S15 IP20
output AC3PH 0..500V 0..625Hz I nom. 65 A Imax 75 A
UL ratings@500Vac 56,3 kVA max (drive) 45,0 kW/ 60 Hp (motor)
Short Circuit Rating: 10000 Arms@500Vac
Aux. Contact Ratings: 5A@250Vac (resistive)/ 3A@250Vac / 5A@30Vdc
FOR FURTHER DETAILS SEE USER MANUAL
Fuse (A) 100 Circ.breaker (A) 100 Cont. A1 (A) 100 Wire size (sqmm) 25 AWG4
application table kW Hp
motor voltage light standard heavy strong
380-415V 30 40 25 35,0 25 35 22 30
440-460V 37 40,0 30 40 30 40 25 35
480-500V 45 60,0 37 50,0 30 40,0 28 38,0
IND.CONT.EQ. 2YF1
E177007
LISTED
MADE IN ITALY

S000261

Figure 1: Nameplate of the SINUS PENTA Drive.

## 2.3. Installing the Equipment

The drives of the SINUS PENTA series are Open Type Equipment – degree of protection IP00 and IP20 – that can be installed inside another enclosure.
The drives must be installed vertically.
The ambient conditions, the instructions for the mechanical assembly and the electrical connections of the drives are detailed in the sections below.

CAUTION

Install the drive in an upright position.
Do not install the drive horizontally or upside-down.

CAUTION

Do not mount any heat-sensitive components on top of the drive to prevent them from damaging due to hot exhaust air.

CAUTION

The drive rear wall may reach high temperatures; make sure that the drive bearing surface is not heat-sensitive.

### 2.3.1. ENVIRONMENTAL REQUIREMENTS FOR THE EQUIPMENT INSTALLATION, STORAGE AND TRANSPORT

Any electronic board installed in the inverters manufactured by TECO is tropicalised. This enhances electrical insulation between the tracks having different voltage ratings and ensures longer life of the components. It is however recommended that the prescriptions below be strictly followed:

| | |
|---|---|
| Operating ambient temperatures | –10 °C to 40 °C with no derating<br>from 40°C to 50°C with no derating or with 2% derating of the rated current for every degree beyond 40°C based on the inverter model and the application category (see OPERATING TEMPERATURES BASED ON APPLICATION CLASSES in the **Installation Instructions** manual). |
| Ambient temperatures for storage and transport | –25 °C to + 70 °C |
| Installation environment | Pollution degree 2 or higher.<br>Do not install in direct sunlight and in places exposed to conductive dust, corrosive gases, vibrations, water sprinkling or dripping (except for IP54 models); do not install in salty environments. |
| Altitude | Max. altitude for installation 2000 m a.s.l. Please contact TECO For installation above 2000 m and up to 4000 m.<br>Above 1000 m, derate the rated current by 1% every 100 m. |
| Operating ambient humidity | From 5% to 95%, from 1g/m$^3$ to 29g/m$^3$, non condensing and non freezing (class 3k3 according to EN50178) |
| Storage ambient humidity | From 5% to 95%, from 1g/m$^3$ to 29g/m$^3$, non condensing and non freezing (class 1k3 according to EN50178) |
| Ambient humidity during transport | Max. 95%, up to 60g/m$^3$; condensation may appear when the equipment is not running (class 2k3 according to EN50178) |
| Storage and operating atmospheric pressure | From 86 to 106 kPa<br>(classes 3k3 and 1k4 according to EN50178) |
| Atmospheric pressure during transport | From 70 to 106 kPa (class 2k3 according to EN50178). |

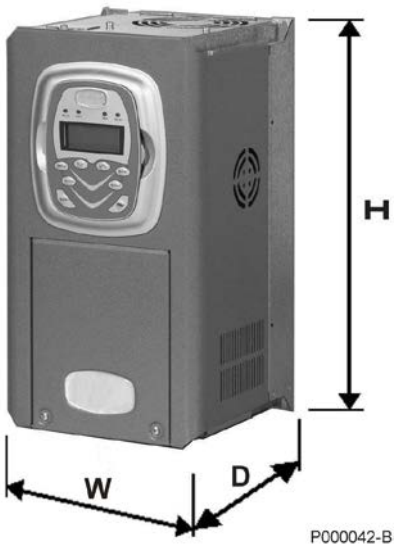
**CAUTION** As ambient conditions strongly affect the drive life, do not install the equipment in places that do not have the above-mentioned ambient conditions.

**CAUTION** Always transport the equipment within its original package.

## 2.3.2. DIMENSIONS, WEIGHT AND DISSIPATED POWER FOR STAND-ALONE MODELS

### 2.3.2.1. IP20 AND IP00 STAND-ALONE MODELS (S05–S60) 2T CLASS

| Size | SINUS PENTA MODEL | W | H | D | Weight | Power dissipated at Inom |
|---|---|---|---|---|---|---|
| | | mm | mm | mm | kg | W |
| S05 | 0007 | 170 | 340 | 175 | 7 | 160 |
| | 0008 | | | | 7 | 170 |
| | 0010 | | | | 7 | 220 |
| | 0013 | | | | 7 | 220 |
| | 0015 | | | | 7 | 230 |
| | 0016 | | | | 7 | 290 |
| | 0020 | | | | 7 | 320 |
| S12 | 0023 | 215 | 401 | 225 | 11 | 390 |
| | 0033 | | | | 12 | 500 |
| | 0037 | | | | 12 | 560 |
| S15 | 0040 | 225 | 466 | 331 | 22.5 | 820 |
| | 0049 | | | | 22.5 | 950 |
| S20 | 0060 | 279 | 610 | 332 | 33.2 | 950 |
| | 0067 | | | | 33.2 | 1250 |
| | 0074 | | | | 36 | 1350 |
| | 0086 | | | | 36 | 1500 |
| S30 | 0113 | 302 | 748 | 421 | 51 | 2150 |
| | 0129 | | | | 51 | 2300 |
| | 0150 | | | | 51 | 2450 |
| | 0162 | | | | 51 | 2700 |
| S41 | 0180 | 500 | 882 | 409 | 117 | 2550 |
| | 0202 | | | | 117 | 3200 |
| | 0217 | | | | 121 | 3450 |
| | 0260 | | | | 121 | 3950 |
| S51 | 0313 | 578 | 882 | 409 | 141 | 4400 |
| | 0367 | | | | 141 | 4900 |
| | 0402 | | | | 141 | 6300 |
| S60 | 0457 | 890 | 1310 | 530 | 260 | 7400 |
| | 0524 | | | | 260 | 8400 |

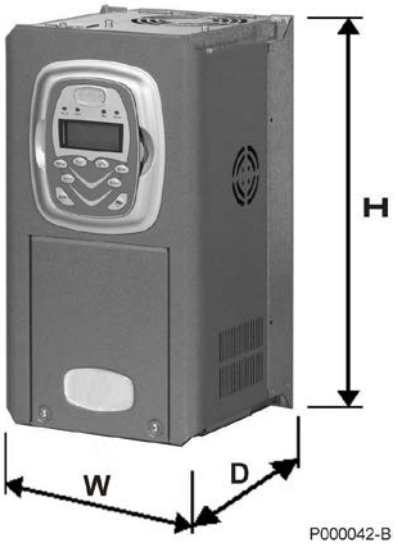



**NOTE** Degree of protection IP20 up to Size S30; IP00 for greater Sizes.

**NOTE** Please refer to the **Installation Instructions** manual for IP54 stand-alone models, box and cabinet models.

### 2.3.2.2. IP20 AND IP00 STAND-ALONE MODELS (S05–S60) 4T CLASS

| Size | SINUS PENTA MODEL | W | H | D | Weight | Power Dissipated at Inom |
|---|---|---|---|---|---|---|
| | | mm | mm | mm | kg | W |
| S05 | 0005 | 170 | 340 | 175 | 7 | 215 |
| | 0007 | | | | 7 | 240 |
| | 0009 | | | | 7 | 315 |
| | 0011 | | | | 7 | 315 |
| | 0014 | | | | 7 | 315 |
| S12 | 0016 | 215 | 401 | 225 | 10.5 | 430 |
| | 0017 | | | | 10.5 | 490 |
| | 0020 | | | | 10.5 | 490 |
| | 0025 | | | | 11.5 | 520 |
| | 0030 | | | | 11.5 | 520 |
| | 0034 | | | | 12.5 | 680 |
| | 0036 | | | | 12.5 | 710 |
| S15 | 0040 | 225 | 466 | 331 | 22.5 | 820 |
| | 0049 | | | | 22.5 | 950 |
| S20 | 0060 | 279 | 610 | 332 | 33.2 | 950 |
| | 0067 | | | | 33.2 | 1250 |
| | 0074 | | | | 36 | 1350 |
| | 0086 | | | | 36 | 1500 |
| S30 | 0113 | 302 | 748 | 421 | 51 | 2150 |
| | 0129 | | | | 51 | 2300 |
| | 0150 | | | | 51 | 2450 |
| | 0162 | | | | 51 | 2700 |
| S41 | 0180 | 500 | 882 | 409 | 117 | 2550 |
| | 0202 | | | | 117 | 3200 |
| | 0217 | | | | 121 | 3450 |
| | 0260 | | | | 121 | 3950 |
| S51 | 0313 | 578 | 882 | 409 | 141 | 4400 |
| | 0367 | | | | 141 | 4900 |
| | 0402 | | | | 141 | 6300 |
| S60 | 0457 | 890 | 1310 | 530 | 260 | 7400 |
| | 0524 | | | | 260 | 8400 |

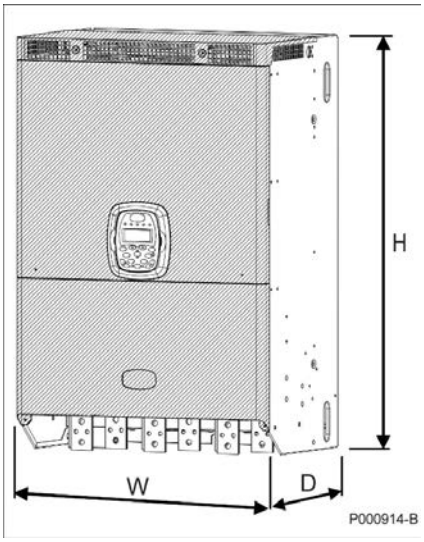



**NOTE** Degree of protection IP20 up to Size S30; IP00 for greater Sizes.

**NOTE** Please refer to the **Installation Instructions** manual for IP54 stand-alone models, box and cabinet models.

### 2.3.2.3. IP20 AND IP00 STAND-ALONE MODELS (S12–S52) 5T AND 6T CLASS

| Size | SINUS PENTA MODEL | W | H | W | Weight | Power dissipated at Inom |
|---|---|---|---|---|---|---|
| | | mm | mm | mm | kg | W |
| S12 5T | 0003 | 215 | 401 | 225 | 10 | 160 |
| | 0004 | | | | 10 | 180 |
| | 0006 | | | | 10.5 | 205 |
| | 0012 | | | | 10.5 | 230 |
| | 0018 | | | | 10.5 | 270 |
| S14 | 0003 | 270 | 527 | 240 | 17.5 | 170 |
| | 0004 | | | | 17.5 | 190 |
| | 0006 | | | | 17.5 | 210 |
| | 0012 | | | | 17.5 | 240 |
| | 0018 | | | | 17.5 | 280 |
| | 0019 | | | | 17.5 | 320 |
| | 0021 | | | | 17.5 | 370 |
| | 0022 | | | | 18 | 470 |
| | 0024 | | | | 18 | 550 |
| | 0032 | | | | 18.5 | 670 |
| S22 | 0042 | 283 | 833 | 353 | 51 | 750 |
| | 0051 | | | | 51 | 950 |
| | 0062 | | | | 54 | 1000 |
| | 0069 | | | | 54 | 1200 |
| S32 | 0076 | 367 | 880 | 400 | 80 | 1400 |
| | 0088 | | | | 80 | 1700 |
| | 0131 | | | | 84 | 2100 |
| | 0164 | | | | 84 | 2500 |
| | 0172 | | | | 84 | N/A |
| S42 | 0181 | 500 | 968 | 409 | 128 | 3450 |
| | 0201 | | | | 128 | 3900 |
| | 0218 | | | | 136 | 4550 |
| | 0259 | | | | 136 | 4950 |
| S52 | 0290 | 578 | 968 | 409 | 160 | 5950 |
| | 0314 | | | | 160 | 6400 |
| | 0368 | | | | 160 | 7000 |
| | 0401 | | | | 160 | 7650 |




**NOTE** Degree of protection IP20 up to Size S32; IP00 for greater Sizes.

**NOTE** Please refer to the **Installation Instructions** manual for IP54 stand-alone models, box and cabinet models.

### 2.3.2.4. MODULAR IP00 STAND-ALONE MODELS (S64–S90)

To obtain high-power inverters, the following individual modules are matched together:
- Control unit, containing the control board and ES842 board
- Power supply unit module, composed of a 3-phase power rectifier and its control and power supply circuits
- Inverter module, composed of an inverter phase and its control circuits
- Braking unit.

Four types of inverter modules are available:

- Basic version
- Version with integrated control unit
- Version with integrated auxiliary supply unit (to be used for those models which are not equipped with the power supply module, Size S64, S74, and S84)
- Version with integrated splitter unit (to be used for the Penta sizes where parallel-connected inverter modules are installed - Size S74, S75, S80, S84, S90).

Match the elements above to obtain the proper inverter dimensioning for your application.

CAUTION **Properly configure ES842 control board inside the control unit. When ordering the inverter, always state the inverter configuration you want to obtain.**

## a) control unit

The control unit can be installed separately from the inverter modules or inside an inverter module (this option must be stated when ordering the inverter). Dimensions of the control unit (separate from the inverter).

| EQUIPMENT | W | H | D | Weight | Dissipated power |
|---|---|---|---|---|---|
| | mm | mm | mm | kg | W |
| Control unit | 222 | 410 | 189 | 6 | 100 |

NOTE In the standard configuration, the control unit is installed on an inverter module.

## b) Inverter modules and supply modules

Configuration: power supply delivered from the mains

Models where no parallel-connected inverter modules are installed (S65 and S70)

| Size | SINUS PENTA Model | Voltage Class | Modules | | Dimensions | | Weight | | | Power dissipated at Inom | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Power Supply Modules | Inverter Modules | Single Module | Min. Overall Dimensions | Power Supply Module | Inverter Module | Overall Weight | Power Supply Module | Inverter Module | Overall Dissipated Pwr |
| | | | | | WxHxD | WxHxD | kg | kg | kg | kW | kW | kW |
| S65 | 0598 | 4T | 1 | 3 | 230x1400x480 (*) | 980x1400x560 | 110 | 110 | 440 | 2.25 | 2.5 | 9.75 |
| | 0748 | 4T | 1 | 3 | | | | | | 2.5 | 2.75 | 10.75 |
| | 0831 | 4T | 1 | 3 | | | | | | 3.0 | 3.3 | 12.9 |
| | 0457 | 5T-6T | 1 | 3 | | | | | | 1.95 | 2.4 | 9.15 |
| | 0524 | 5T-6T | 1 | 3 | | | | | | 2.0 | 2.6 | 9.8 |
| | 0598 | 5T-6T | 1 | 3 | | | | | | 2.4 | 2.95 | 11.25 |
| | 0748 | 5T-6T | 1 | 3 | | | | | | 2,7 | 3.25 | 12.45 |
| S70 | 0831 | 5T-6T | 2 | 3 | | 1230x1400x560 | | | 550 | 1.6 | 3.9 | 14.9 |

**(*)**: When housing the control unit, the module depth becomes 560 mm.

Models including parallel-connected inverter modules (S75, S80 and S90)

| Size | SINUS PENTA Model | Voltage Class | Modules | | Dimensions | | Weight | | | Power dissipated at Inom | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Power Supply Modules | Inverter Modules (**) | Single Module | Min. Overall Dimensions | Power Supply Module | Inverter Module | Overall Weight | Power Supply Module | Inverter Module | Overall Dissipated Pwr |
| | | | | | WxHxD | WxHxD | kg | kg | kg | kW | kW | kW |
| S75 | 0964 | 4T | 2 | 6 | 230x1400x480 (*) | 1980x1400x560 | 110 | 110 | 880 | 2 | 2.2 | 17.2 |
| | 1130 | 4T | 2 | 6 | | | | | | 2.25 | 2.4 | 18.9 |
| | 1296 | 4T | 2 | 6 | | | | | | 2.75 | 2.6 | 21.1 |
| | 0964 | 5T-6T | 2 | 6 | | | | | | 2 | 2.4 | 18.4 |
| | 1130 | 5T-6T | 2 | 6 | | | | | | 2.4 | 3.0 | 22.8 |
| S80 | 1296 | 5T-6T | 3 | 6 | | 2230x1400x560 | | | 990 | 1.9 | 3.2 | 24.9 |
| S90 | 1800 | 4T | 3 | 9 | | 2980x1400x560 | | | 1320 | 2.25 | 2.5 | 29.25 |
| | 2076 | 4T | 3 | 9 | | | | | | 2.5 | 2.75 | 32.25 |
| | 1800 | 5T-6T | 3 | 9 | | | | | | 2.4 | 2.95 | 33.75 |
| | 2076 | 5T-6T | 3 | 9 | | | | | | 2.7 | 3.25 | 37.35 |

**(*)**: When housing the control unit or the splitter unit, the module depth becomes 560 mm.
**(**)**: Three inverter modules are to be provided with an integrated splitter unit.

## c) Inverter modules only

Configuration:

- inverter powered directly from a DC power supply source;
- inverter used as a regenerative power supply unit (for more details, please refer to the technical documentation relating to the Regenerative Penta Drive)

Models where no parallel-connected inverter modules are installed (S64)

| Size | SINUS PENTA Model | Voltage Class | Modules | | Dimensions | | Weight | | | Power Dissipated at Inom | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Inverter Modules with Auxiliary Power Supply Unit | Inverter Modules (**) | Single Module | Min. Overall Dimensions | Inverter Modules with Auxiliary Power Supply Unit | Inverter Module | Overall Weight | Single Inverter Module | Overall Dissipated Power |
| | | | | | WxHxD | WxHxD | kg | kg | kg | kW | kW |
| S64 | 0598 | 4T | 1 | 2 | 230x1400 x480(*) | 730x1400 x560 | 118 | 110 | 338 | 2.5 | 7.5 |
| | 0748 | 4T | 1 | 2 | | | | | | 2.75 | 8.25 |
| | 0831 | 4T | 1 | 2 | | | | | | 3.3 | 9.9 |
| | 0457 | 5T-6T | 1 | 2 | | | | | | 2.4 | 7.2 |
| | 0524 | 5T-6T | 1 | 2 | | | | | | 2.6 | 7.8 |
| | 0598 | 5T-6T | 1 | 2 | | | | | | 2.95 | 8.85 |
| | 0748 | 5T-6T | 1 | 2 | | | | | | 3.25 | 9.75 |
| | 0831 | 5T-6T | 1 | 2 | | | | | | 3.9 | 11.7 |

(*): When housing the control unit or the auxiliary power supply unit, the module depth is 560 mm.
(**): One inverter module must be provided with an integrated auxiliary power supply unit.

Models including parallel-connected inverter modules (S74 and S84)

| Size | SINUS PENTA Model | Voltage Class | Modules | | Dimensions | | Weight | | | Power Dissipated at Inom | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Inverter Modules with Auxiliary Power Supply Unit | Inverter Modules (**) | Single Module | Min. Overall Dimensions | Inverter Modules with Auxiliary Power Supply Unit | Inverter Module | Overall Weight | Single Inverter Module | Overall Dissipated Power |
| | | | | | WxHxD | WxHxD | kg | kg | kg | kW | kW |
| S74 | 0964 | 4T | 2 | 4 | 230x1400 x480(*) | 1480x1400 x560 | 118 | 110 | 676 | 2.2 | 12.2 |
| | 1130 | 4T | 2 | 4 | | | | | | 2.4 | 14.4 |
| | 1296 | 4T | 2 | 4 | | | | | | 2.6 | 15.6 |
| | 0964 | 5T-6T | 2 | 4 | | | | | | 2.4 | 14.4 |
| | 1130 | 5T-6T | 2 | 4 | | | | | | 3.0 | 18.0 |
| | 1296 | 5T-6T | 2 | 4 | | | | | | 3.2 | 19.2 |
| S84 | 1800 | 4T | 3 | 6 | | 2230x1400 x560 | | | 1014 | 2.5 | 22.5 |
| | 2076 | 4T | 3 | 6 | | | | | | 2.75 | 24.75 |
| | 1800 | 5T-6T | 3 | 6 | | | | | | 2.95 | 26.55 |
| | 2076 | 5T-6T | 3 | 6 | | | | | | 3.25 | 29.25 |

(*): When housing the control unit or the splitter unit or the auxiliary power supply unit, the module depth is 560 mm.
(**): Three inverter modules are to be provided with an integrated splitter unit.

## 2.3.3. POWER TERMINALS / BARS

| | DESCRIPTION |
|---|---|
| 41/R – 42/S – 43/T | Inputs for three-phase supply (the phase sequence is not important) |
| 44/U – 45/V – 46/W | Three-phase motor outputs |
| 47/+ | Link to the DC voltage positive pole. It can be used for<br>-DC voltage supply;<br>- DC reactor;<br>- the external braking resistor and the external braking unit (for the drive models which are NOT provided with terminal **50/+** dedicated to the external braking resistor)<br>- the external braking unit. |
| 47/D | When fitted, link to the positive pole of the continuous AC rectified voltage. It can be used for the DC reactor—if no DC reactor is used, terminal 47/D must be short-circuited to terminal **47/+** using a cable/bar having the same cross-section as the cables used for power supply; factory setting). |
| 48/B | When available, it can be used to connect the IGBT brake for braking resistors. |
| 49/– | Link to the negative pole of the DC voltage. It can be used for DC power supply and the external braking unit (for the drive models which are NOT provided with terminal **52/-** dedicated to the external braking unit). |
| 50/+ | When available, it can be used to connect the positive pole of the DC voltage to be used for the external braking resistor only. |

**S05 (4T)–S15–S20 Terminal board:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 41/R | 42/S | 43/T | 44/U | 45/V | 46/W | 47/+ | 48/B | 49/– |

**S05 (2T) Terminal board:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41/R | 42/S | 43/T | 44/U | 45/V | 46/W | 47/+ | 47/D | 48/B | 49/– |

**CAUTION** Connection bars **47D** and **47+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47D** and **47+** after removing the short-circuit.

**CAUTION** If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.

**CAUTION** Use terminals **47/+** and **48/B** if an external braking resistor is to be installed.

S12 Terminal board (2T-4T)-S14:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41/R | 42/S | 43/T | 47/+ | 47/D | 48/B | 49/– | 44/U | 45/V | 46/W |

**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.

**CAUTION**

If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.

**CAUTION**

Use terminals **47/+** and **48/B** if an external braking resistor is to be installed.

S12 Terminal board (5T):

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 41/R | 42/S | 43/T | 47/+ | 47/D | 49/– | 44/U | 45/V | 46/W |

S22–32 Terminal board:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 48/B | 50/+ | 47/+ | 47/D | 49/– | 41/R | 42/S | 43/T | 44/U | 45/V | 46/W |

**CAUTION**

Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.

**CAUTION**

If DC supply is required and if an external braking resistor is to be installed, remove the short-circuit between **47/D** and **47/+** and use terminal **47/+**.

**NOTE**

Connect the braking resistor to terminals **50/+** and **48/B**.
Avoid using terminals **50/+** and **48/B** for applying DC power supply.

S30 Terminal board:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41/R | 42/S | 43/T | 44/U | 45/V | 46/W | 47/+ | 49/– | 48/B | 50/+ |

**NOTE**

Connect the braking resistor to terminals **50/+** and **48/B**.
Avoid using terminals **50/+** and **48/B** for applying DC power supply.

**Connection bars for S41–S42–S51–S52:**

**CAUTION** Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.

**CAUTION** Please contact TECO if DC supply is to be applied to SINUS PENTA S41, S42, S51, S52.

**NOTE** Use terminals **47/+** and **49/–** if the external braking unit is to be installed.

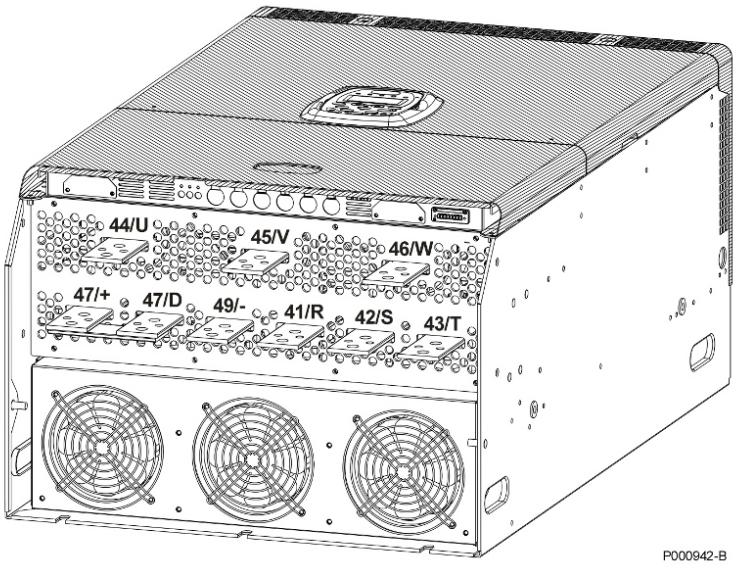



Figure 2: Connection bars in S41–S42–S51–S52

### 2.3.4. CONNECTION BARS FOR S60 INVERTERS

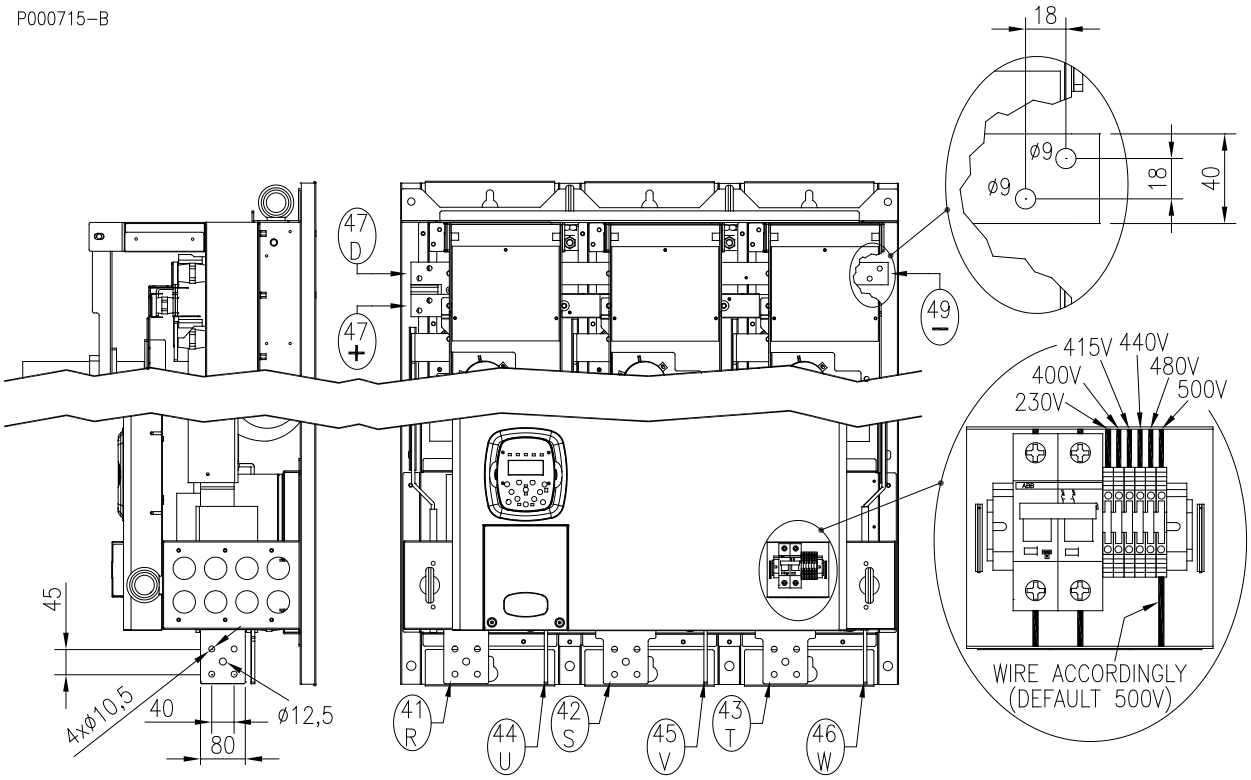



Figure 3: S60 Connection bars

shows the location and dimension of the bars connecting S60 SINUS PENTA drives to the mains and the motor. The figure also shows the position and the wiring instructions for the built-in power supply transformer. The transformer must be wired based on the rated supply voltage being used.

**CAUTION** Connection bars **47/D** and **47/+** are short-circuited as a factory setting. The DC choke, if any, shall be linked between bars **47/D** and **47/+** after removing the short-circuit.

**CAUTION** Please contact TECO if DC supply is to be applied to SINUS PENTA S60.

### 2.3.5. CONNECTION BARS FOR MODULAR INVERTERS S64-S70

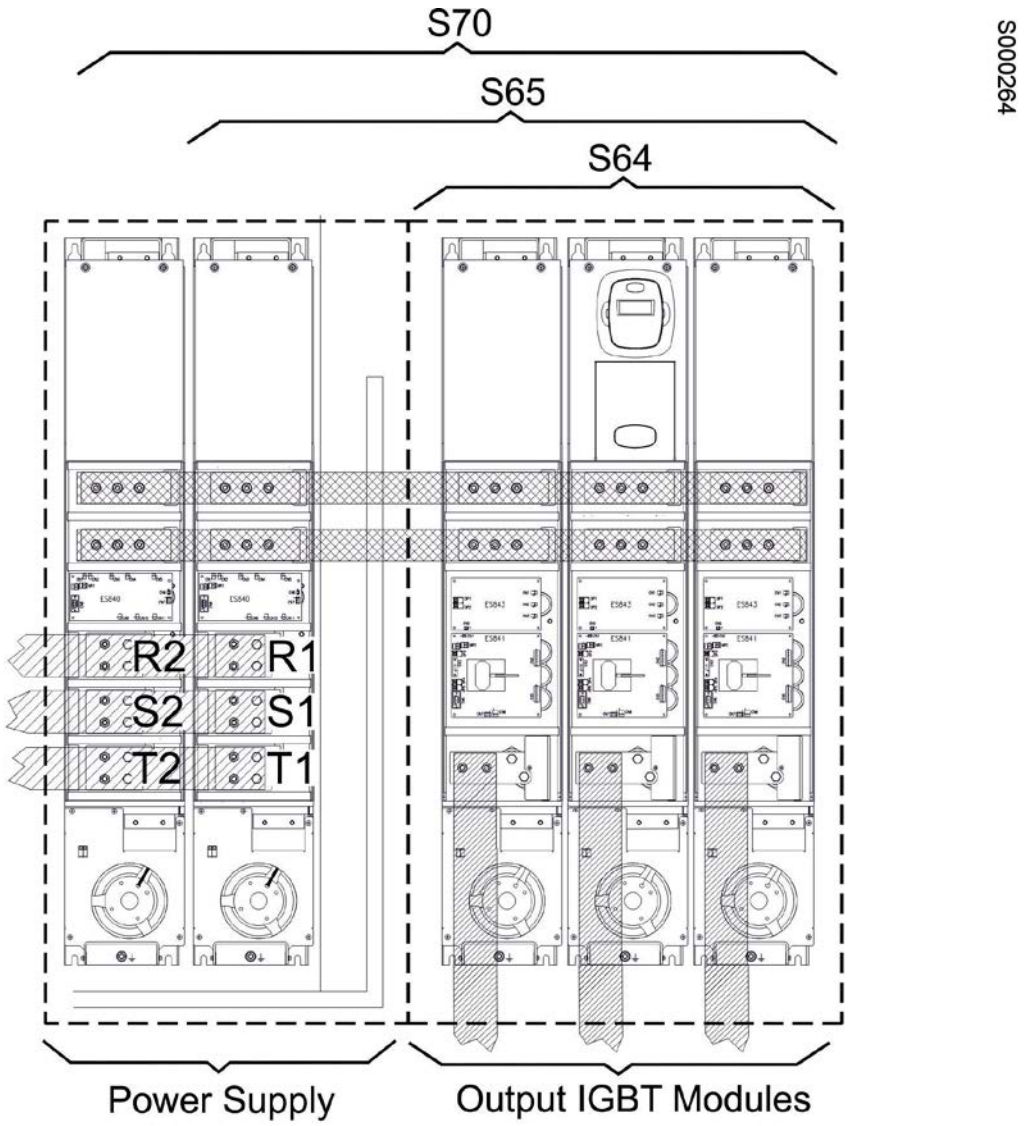



Figure 4: Connection bars for S64–S70

### 2.3.6. CONNECTION BARS FOR MODULAR INVERTERS S74–S80

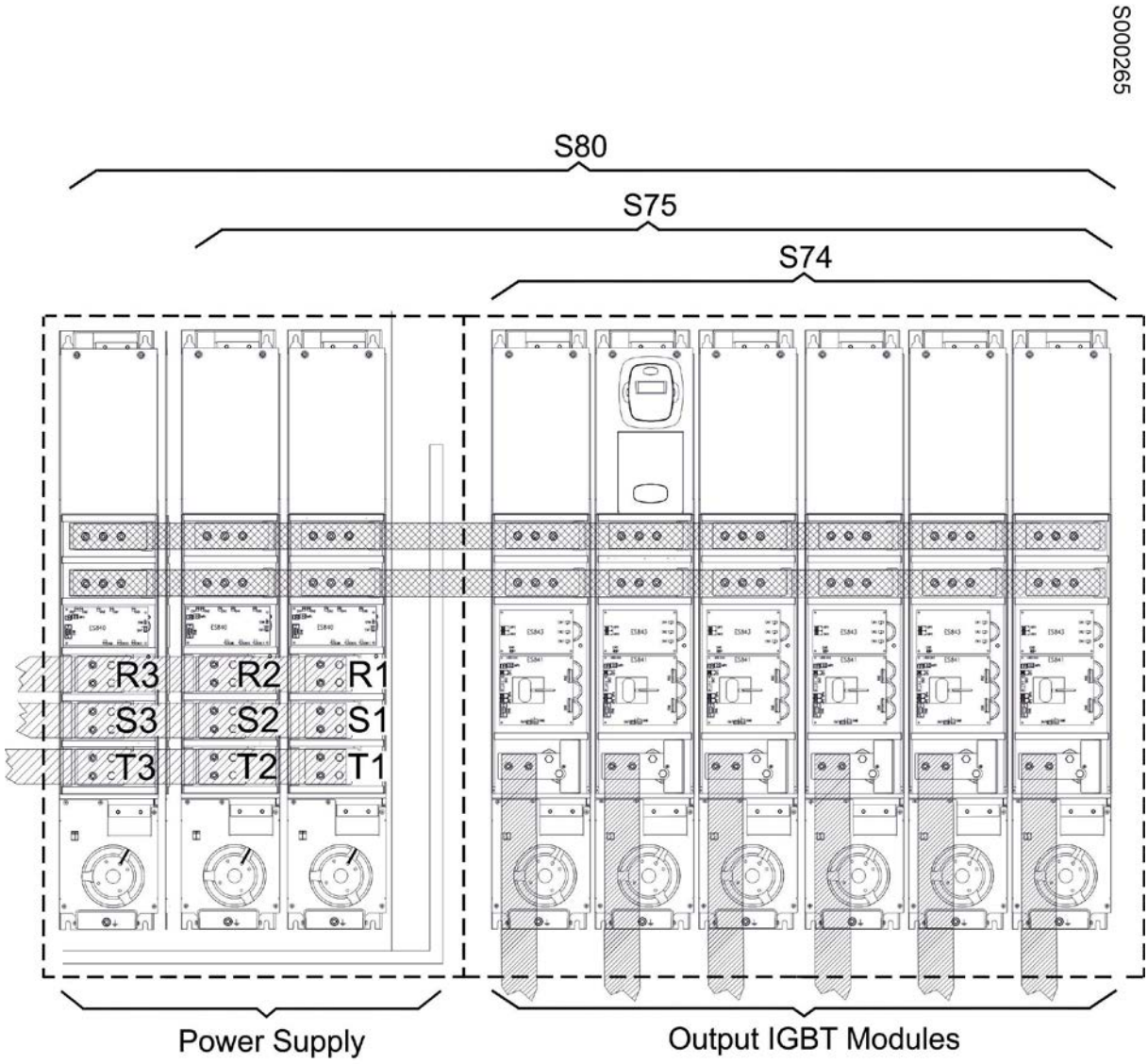



Figure 5: Connection bars for S74-S80

## 2.3.7. CONNECTION BARS FOR MODULAR INVERTERS S84–S90

S000266

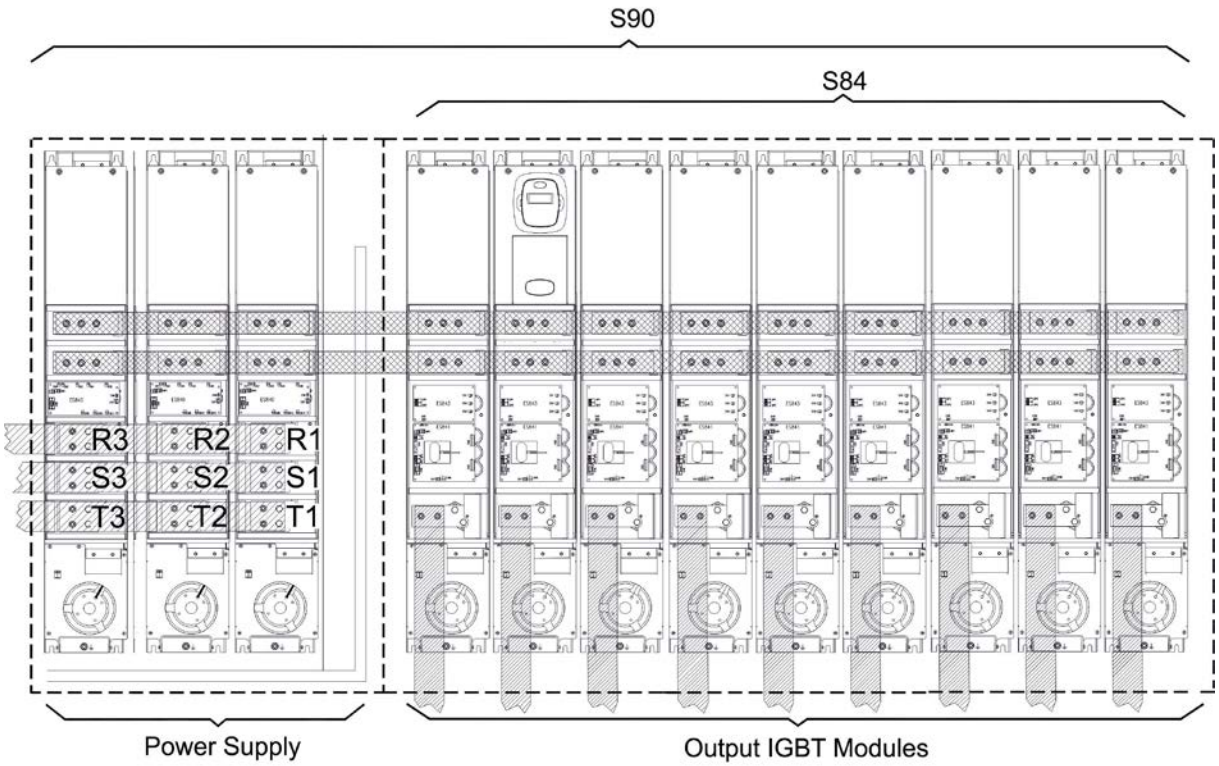



Figure 6: Connection bars for S84-S90

**CAUTION** Please contact TECO if DC supply is to be applied to SINUS PENTA S64 to S80.

**CAUTION** The mounting layout in the figures above may vary based on the accessories being used (input and output chokes, sinusoidal filters, harmonic filters).

## 2.3.8. LAY-OUT OF THE AUXILIARY POWER SUPPLY TERMINALS

The auxiliary power supply terminals are provided in the Penta models requiring auxiliary power supply links to be used to power air-cooling systems or to power internal circuits.

| Inverter | Terminal | Description | Ratings |
|---|---|---|---|
| S64–S74-S84 | 63/Raux<br>65/Saux<br>67/Taux | Inputs for auxiliary 3-phase power supply | 380-500Vac 100mA for 47-class inverters<br>660-690Vac 0.5A for 6T-class inverters |
| S65–S64–S70–S74-S75–S80-S84-S90 | 61–62 | Inputs for fan power supply | 230Vac/2A |

## 2.3.9. CROSS-SECTIONS OF THE POWER CABLES AND SIZES OF THE SAFETY DEVICES

The minimum requirements of the inverter cables and the protective devices needed to protect the system against short-circuits are given in the tables below. It is however recommended that the applicable regulations in force be observed; also check if voltage drops occur for cable links longer than 100m.
For the largest inverter sizes, special links with multiple conductors are provided for each phase. For example, 2x150 in the column relating to the cable cross-section means that two 150mm$^2$ parallel conductors are required for each phase.
Multiple conductors shall have the same length and must run parallel to each others, thus ensuring even current delivery at any frequency value. Paths having the same length but a different shape deliver uneven current at high frequency.
Also, do not exceed the tightening torque for the terminals to the bar connections. For connections to bars, the tightening torque relates to the bolt tightening the cable lug to the copper bar. The cross-section values given in the tables below apply to copper cables.
The links between the motor and the Penta drive must have the same lengths and must follow the same paths. Use 3-phase cables where possible.

### 2.3.9.1. 2T VOLTAGE CLASS

| Size | SINUS PENTA Model | Inverter Rated Current | Cable Cross-section Fitting the Terminal | Cable Stripping | Tightening Torque | Cable Cross-section to Mains and Motor Side | Fast Fuses (700V) + Disc. Switch | Magnetic Circuit Breaker | AC1 Contactor |
|---|---|---|---|---|---|---|---|---|---|
| | | A | mm² (AWG/kcmils) | mm | Nm | mm² (AWG/kcmils) | A | A | A |
| S05 | 0007 | 12.5 | 0.5÷10 (20÷6AWG) | 10 | 1.2-1.5 | 2.5 (12AWG) | 16 | 16 | 25 |
| | 0008 | 15 | | 10 | 1.2-1.5 | | 16 | 16 | 25 |
| | 0010 | 17 | | 10 | 1.2-1.5 | 4 (10AWG) | 20 | 25 | 25 |
| | 0013 | 19 | | 10 | 1.2-1.5 | | 20 | 25 | 25 |
| | 0015 | 23 | | 10 | 1.2-1.5 | | 25 | 25 | 25 |
| | 0016 | 27 | | 10 | 1.2-1.5 | 8 (8AWG) | 32 | 32 | 45 |
| | 0020 | 30 | | 10 | 1.2-1.5 | | 50 | 50 | 45 |
| S12 | 0023 | 38 | 0.5÷25 (20÷4AWG) | 18 | 2.5 | 10 (6AWG) | 63 | 63 | 60 |
| | 0033 | 51 | | 18 | 2.5 | 16 (5AWG) | 80 | 80 | 80 |
| | 0037 | 65 | | 18 | 2.5 | 25 (4AWG) | 80 | 80 | 80 |
| S15 | 0040 | 72 | | 15 | 2.5 | | 100 | 100 | 100 |
| | 0049 | 80 | 4÷25 (12÷4AWG) | 15 | 2.5 | | 125 | 100 | 100 |
| S20 | 0060 | 88 | 25÷50 (3÷1/0AWG) | 24 | 6-8 | 35 (2AWG) | 125 | 125 | 125 |
| | 0067 | 103 | | 24 | 6-8 | 50 (1/0AWG) | 125 | 125 | 125 |
| | 0074 | 120 | | 24 | 6-8 | | 160 | 160 | 145 |
| | 0086 | 135 | | 24 | 6-8 | | 200 | 160 | 160 |
| S30 | 0113 | 180 | 35÷185 (2AWG÷ 350kcmils) | 30 | 10 | 95 (4/0AWG) | 250 | 200 | 250 |
| | 0129 | 195 | | 30 | 10 | 120 (250kcmils) | 250 | 250 | 250 |
| | 0150 | 215 | | 30 | 10 | | 315 | 400 | 275 |
| | 0162 | 240 | | 30 | 10 | | 400 | 400 | 275 |
| S41 | 0180 | 300 | Bus bar | - | 30 | 185 (400kcmils) | 350 | 400 | 400 |
| | 0202 | 345 | Bus bar | - | 30 | 240 (500kcmils) | 500 | 400 | 450 |
| | 0217 | 375 | Bus bar | - | 30 | 2x120 (2x4/0AWG) | 550 | 630 | 450 |
| | 0260 | 425 | Bus bar | - | 30 | 2x120 (2x250kcmils) | 630 | 630 | 500 |
| S51 | 0313 | 480 | Bus bar | - | 50 | 2x150 (2x300kcmils) | 700 | 630 | 550 |
| | 0367 | 550 | Bus bar | - | 50 | 2x185 (2x350kcmils) | 800 | 800 | 600 |
| | 0402 | 680 | Bus bar | - | 50 | 2x240 (2x500kcmils) | 1000 | 800 | 700 |
| S60 | 0457 | 720 | Bus bar | - | 50 | 3x150 (3x300kcmils) | 1000 | 800 | 800 |
| | 0524 | 800 | Bus bar | - | 50 | 3x185 (3x350kcmils) | 1000 | 1000 | 1000 |

**CAUTION**

Always use the correct cable cross-sections and activate the protective devices provided for the inverter. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.

### 2.3.9.2. 4T VOLTAGE CLASS

| Size | SINUS PENTA Model | Inverter Rated Current | Cable Cross-section Fitting the Terminal | Cable Peeling | Tightening Torque | Cable Cross-section to Mains and Motor Side | Fast Fuses (700V) + Disc. Switch | Magnetic Circuit Breaker | AC1 Contactor |
|---|---|---|---|---|---|---|---|---|---|
| | | A | mm² (AWG/kcmils) | mm | Nm | mm² (AWG/kcmils) | A | A | A |
| S05 | 0005 | 10.5 | 0.5÷10 (20÷6AWG) | 10 | 1.2-1.5 | 2.5 (12AWG) | 16 | 16 | 25 |
| | 0007 | 12.5 | | 10 | 1.2-1.5 | | 16 | 16 | 25 |
| | 0009 | 16.5 | | 10 | 1.2-1.5 | 4 (10AWG) | 25 | 25 | 25 |
| | 0011 | 16.5 | | 10 | 1.2-1.5 | | 25 | 25 | 25 |
| | 0014 | 16.5 | | 10 | 1.2-1.5 | | 32 | 32 | 30 |
| S12 | 0016 | 26 | 0.5÷10 (20÷6AWG | 10 | 1.2-1.5 | 10 (6AWG) | 40 | 40 | 45 |
| | 0017 | 30 | | 10 | 1.2-1.5 | | 40 | 40 | 45 |
| | 0020 | 30 | | 10 | 1.2-1.5 | | 40 | 40 | 45 |
| | 0025 | 41 | | 10 | 1.2-1.5 | | 63 | 63 | 55 |
| | 0030 | 41 | | 10 | 1.2-1.5 | | 63 | 63 | 60 |
| | 0034 | 57 | 0.5÷25 (20÷4AWG | 18 | 2.5 | 16 (5AWG) | 100 | 100 | 100 |
| | 0036 | 60 | | 18 | 2.5 | 25 (4AWG) | 100 | 100 | 100 |
| S15 | 0040 | 72 | 0.5÷25 (20÷4AWG) | 15 | 2.5 | 25 (4AWG) | 100 | 100 | 100 |
| | 0049 | 80 | 4÷25 (12÷4AWG) | 15 | 2.5 | | 125 | 100 | 100 |
| S20 | 0060 | 88 | 25÷50 (3÷1/0 AWG) | 24 | 6-8 | 35 (2AWG) | 125 | 125 | 125 |
| | 0067 | 103 | | 24 | 6-8 | 50 (1/0AWG) | 125 | 125 | 125 |
| | 0074 | 120 | | 24 | 6-8 | | 160 | 160 | 145 |
| | 0086 | 135 | | 24 | 6-8 | | 200 | 160 | 160 |
| S30 | 0113 | 180 | 35÷185 (2AWG÷ 350kcmils) | 30 | 10 | 95 (4/0AWG) | 250 | 200 | 250 |
| | 0129 | 195 | | 30 | 10 | 120 (250kcmils) | 250 | 250 | 250 |
| | 0150 | 215 | | 30 | 10 | | 315 | 400 | 275 |
| | 0162 | 240 | | 30 | 10 | | 400 | 400 | 275 |

(continued)

(continued)

| Size | SINUS PENTA Model | Inverter Rated Current | Cable Cross-section Fitting the Terminal | Cable Stripping | Tightening Torque | Cable Cross-section to Mains and Motor Side | Fast Fuses (700V) + Disc. Switch | Magnetic Circuit Breaker | AC1 Contactor |
|---|---|---|---|---|---|---|---|---|---|
| | | A | mm² (AWG/kcmils) | mm | Nm | mm² (AWG/kcmils) | A | A | A |
| S41 | 0180 | 300 | Bus bar | - | 30 | 185 (400kcmils) | 350 | 400 | 400 |
| | 0202 | 345 | Bus bar | - | 30 | 240 (500kcmils) | 500 | 400 | 450 |
| | 0217 | 375 | Bus bar | - | 30 | 2x120 (2x4/0AWG) | 550 | 630 | 450 |
| | 0260 | 425 | Bus bar | - | 30 | 2x120 (2x250kcmils) | 630 | 630 | 500 |
| S51 | 0313 | 480 | Bus bar | - | 50 | 2x150 (2x300kcmils) | 700 | 630 | 550 |
| | 0367 | 550 | Bus bar | - | 50 | 2x185 (2x350kcmils) | 800 | 800 | 600 |
| | 0402 | 680 | Bus bar | - | 50 | 2x240 (2x500kcmils | 1000 | 800 | 700 |
| S60 | 0457 | 720 | Bus bar | - | 50 | 3x150 (3x300kcmils) | 1000 | 800 | 800 |
| | 0524 | 800 | Bus bar | - | 50 | 3x185 (3x350kcmils) | 1000 | 1000 | 1000 |
| S65 | 0598 | 900 | Bus bar | - | M10: 50 M12: 110 | 3x240 (3x500kcmils) | 1250 | 1250 | 1000 |
| | 0748 | 1000 | Bus bar | - | M10: 50 M12: 110 | 3x240 (3x500kcmils) | 1250 | 1250 | 1200 |
| | 0831 | 1200 | Bus bar | - | M10: 50 M12: 110 | 4x240 (4x500kcmils) | 1600 | 1600 | 1600 |
| S75 | 0964 | 1480 | Bus bar | - | M10: 50 M12: 110 | 6x150 (6x300kcmils) | 2x1000 | 2000 | 2x1000 |
| | 1130 | 1700 | Bus bar | - | M10: 50 M12: 110 | 6x185 (6x350kcmils) | 2x1250 | 2000 | 2x1200 |
| | 1296 | 2100 | Bus bar | - | M10: 50 M12: 110 | 6x240 (6x500kcmils) | 2x1250 | 2500 | 2x1200 |
| S90 | 1800 | 2600 | Bus bar | - | M10: 50 M12: 110 | 9x240 (3x500kcmils) | 3x1250 | 4000 | 3x1000 |
| | 2076 | 3000 | Bus bar | - | M10: 50 M12: 110 | 9x240 (3x500kcmils) | 3x1250 | 4000 | 3x1200 |

**CAUTION**

Always use the correct cable cross-sections and activate the protective devices provided for the inverter. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.

| Size | SINUS PENTA Model | Rated Output Current | Rated Input Current | Cable Cross-section Fitting the Terminal | Tightening Torque | Motor Cable Cross-section |
|---|---|---|---|---|---|---|
| | | A | Adc | $mm^2$ (AWG/kcmils) | Nm | $mm^2$ (AWG/kcmils) |
| S64 | 0598 | 900 | 1000 | Bus bar | M10: 50<br>M12: 110 | 3x240 (3x500kcmils) |
| | 0748 | 1000 | 1100 | Bus bar | M10: 50<br>M12: 110 | 3x240 (3x500kcmils) |
| | 0831 | 1200 | 1400 | Bus bar | M10: 50<br>M12: 110 | 4x240 (4x500kcmils) |
| S74 | 0964 | 1480 | 1750 | Bus bar | M10: 50<br>M12: 110 | 6x150 (6x300kcmils) |
| | 1130 | 1700 | 2000 | Bus bar | M10: 50<br>M12: 110 | 6x185 (6x350kcmils) |
| | 1296 | 2100 | 2280 | Bus bar | M10: 50<br>M12: 110 | 6x240 (6x500kcmils) |
| S84 | 1800 | 2600 | 2860 | Bus bar | M10: 50<br>M12: 110 | 9x240 (9x500kcmils) |
| | 2076 | 3000 | 3300 | Bus bar | M10: 50<br>M12: 110 | 9x240 (9x500kcmils) |

**CAUTION**

Always use the correct cable cross-sections and activate the protective devices installed on the DC power supply line. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.

### 2.3.9.3. 5T AND 6T VOLTAGE CLASSES

| Size | SINUS PENTA | Inverter Rated Current | Terminal Cross-section | Cable Stripping | Tightening Torque | Cable Cross-section to Mains and Motor Side | Fast Fuses (700V) + Disc. Switch | Magnetic Circuit Breaker | AC1 Contactor |
|---|---|---|---|---|---|---|---|---|---|
| | | A | mm² (AWG or kcmils) | mm | Nm | mm² (AWG or kcmils) | A | A | A |
| S12 5T S14 6T | 0003 | 7 | 0.5÷16 (20÷5AWG) | 10 | 1.2-1.5 | 2.5 (12AWG) | 16 | 16 | 25 |
| | 0004 | 9 | | 10 | 1.2-1.5 | | 16 | 16 | 25 |
| | 0006 | 11 | | 10 | 1.2-1.5 | 4 (10AWG) | 32 | 32 | 30 |
| | 0012 | 13 | | 10 | 1.2-1.5 | | 32 | 32 | 30 |
| | 0018 | 17 | | 10 | 1.2-1.5 | | 32 | 32 | 30 |
| S14 | 0019 | 21 | 0.5÷25 (20÷4 AWG) | 18 | 2.5-4.5 | 10 (6AWG) | 16 | 16 | 25 |
| | 0021 | 25 | | 18 | 2.5-4.5 | | 16 | 16 | 25 |
| | 0022 | 33 | | 18 | 2.5-4.5 | | 32 | 32 | 30 |
| | 0024 | 40 | | 18 | 2.5-4.5 | | 32 | 32 | 30 |
| | 0032 | 52 | | 18 | 2.5-4.5 | 16 (5AWG) | 32 | 32 | 30 |
| S22 | 0042 | 60 | 25÷50 (4÷1/0 AWG | 20 | 2.5-5 | 35 (2 AWG) | 40 | 40 | 45 |
| | 0051 | 80 | | 20 | 2.5-5 | | 40 | 40 | 45 |
| | 0062 | 85 | | 20 | 2.5-5 | 50 (1/0AWG) | 63 | 63 | 60 |
| | 0069 | 100 | | 20 | 2.5-5 | | 63 | 63 | 60 |
| S32 | 0076 | 125 | 25÷95 (4÷4/0AWG) 35÷150 (2/0AWG÷ 300kcmils) | 30 | 15-20 | 70 (2/0AWG) | 100 | 100 | 100 |
| | 0088 | 150 | | 30 | 15-20 | | 100 | 100 | 100 |
| | 0131 | 190 | | 30 | 15-20 | 120 (250kcmils) | 100 | 100 | 100 |
| | 0164 | 230 | | 30 | 15-20 | | 125 | 125 | 125 |
| | 0172 | 265 | | 30 | 15-20 | | N/A | N/A | N/A |
| S42 | 0181 | 305 | Bus bar | - | 30 | 240 (500kcmils) | 400 | 400 | 400 |
| | 0201 | 330 | Bus bar | - | 30 | | 450 | 400 | 450 |
| | 0218 | 360 | Bus bar | - | 30 | 2x120 (2x250kcmils) | 500 | 400 | 450 |
| | 0259 | 400 | Bus bar | - | 30 | | 630 | 630 | 500 |
| S52 | 0290 | 450 | Bus bar | - | 50 | 2x150 (2x300kcmils) | 630 | 630 | 550 |
| | 0314 | 500 | Bus bar | - | 50 | | 700 | 630 | 550 |
| | 0368 | 560 | Bus bar | - | 50 | 2x185 (2x350kcmils) | 800 | 800 | 600 |
| | 0401 | 640 | Bus bar | - | 50 | 2x240 (2x500kcmils) | 900 | 800 | 700 |
| S65 | 0457 | 720 | Bus bar | - | M10: 50 M12: 110 | 3x150 (3x300kcmils) | 900 | 800 | 800 |
| | 0524 | 800 | Bus bar | - | M10: 50 M12: 110 | 3x185 (3x350kcmils) | 1000 | 1000 | 1000 |
| | 0598 | 900 | Bus bar | - | M10: 50 M12: 110 | 3x240 (3x500kcmils) | 1250 | 1250 | 1000 |
| | 0748 | 1000 | Bus bar | - | M10: 50 M12: 110 | | 1400 | 1250 | 1200 |
| S70 | 0831 | 1200 | Bus bar | - | M10: 50 M12: 110 | 4x240 (4x500kcmils) | 2x800 | 1600 | 2x800 |
| S75 | 0964 | 1480 | Bus bar | - | M10: 50 M12: 110 | 6x150 (6x300kcmils) | 2x1000 | 2000 | 2x1000 |
| | 1130 | 1700 | Bus bar | - | M10: 50 M12: 110 | 6x185 (6x400kcmils) | 2x1250 | 2000 | 2x1000 |
| S80 | 1296 | 2100 | Bus bar | - | M10: 50 M12: 110 | 6x240 (6x500kcmils) | 3x1000 | 2500 | 3x1000 |
| S90 | 1800 | 2600 | Bus bar | - | M10: 50 M12: 110 | 9x240 (9x500kcmils) | 3x1000 | 4000 | 3x1000 |
| | 2076 | 3000 | Bus bar | - | M10: 50 M12: 110 | 9x240 (9x500kcmils) | 3x1250 | 4000 | 3x1000 |

**CAUTION** Always use the correct cable cross-sections and activate the protective devices provided for the inverter. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.

**NOTE** In modular sizes S65–S90, each supply arm shall be protected by a separate fuse (see table above).

| Size | SINUS PENTA Model | Rated Output Current | Rated Input Current | Cable Cross-section Fitting the Terminal | Tightening Torque | Motor Cable Cross-section |
|---|---|---|---|---|---|---|
| | | A | Adc | $mm^2$ (AWG or kcmils) | Nm | $mm^2$ (AWG or kcmils) |
| S64 | 0457 | 720 | 750 | Bus bar | M10: 50<br>M12: 110 | 3x150 (3x300kcmils) |
| | 0524 | 800 | 840 | Bus bar | M10: 50<br>M12: 110 | 3x185 (3x350kcmils) |
| | 0598 | 900 | 950 | Bus bar | M10: 50<br>M12: 110 | 3x240 (3x500kcmils) |
| | 0748 | 1000 | 1070 | Bus bar | M10: 50<br>M12: 110 | 3x240 (3x500kcmils) |
| | 0831 | 1200 | 1190 | Bus bar | M10: 50<br>M12: 110 | 4x240 (4x500kcmils) |
| S74 | 0964 | 1480 | 1500 | Bus bar | M10: 50<br>M12: 110 | 6x150 (6x300kcmils) |
| | 1130 | 1700 | 1730 | Bus bar | M10: 50<br>M12: 110 | 6x185 (6x400kcmils) |
| | 1296 | 2100 | 1980 | Bus bar | M10: 50<br>M12: 110 | 6x240 (6x500kcmils) |
| S84 | 1800 | 2600 | 2860 | Bus bar | M10: 50<br>M12: 110 | 9x240 (9x500kcmils) |
| | 2076 | 3000 | 3300 | Bus bar | M10: 50<br>M12: 110 | 9x240 (9x500kcmils) |

**CAUTION** Always use the correct cable cross-sections and activate the protective devices installed on the DC power supply line. Failure to do so will cause the non-compliance to standard regulations of the system where the inverter is installed.

## 2.3.10. INVERTER AND MOTOR EARTH CONNECTION

A bolted screw for the earthing of the inverter enclosure is located close to the power wiring terminals. The screw can be located by the symbol below:

Always earth the inverter to a state-of-the-art mains. To reduce disturbance and radiated interference to a minimum, connect the motor earthing conductor directly to the inverter following a parallel path to the motor supply cables.

**DANGER**

Always connect the inverter earthing terminal to the grid earthing using a conductor complying with the safety regulations in force (see table below).
Always connect the motor casing to the inverter earth to avoid dangerous voltage peaks and electrical shock hazard.
Always provide proper earthing of the inverter frame and the motor casing.

**NOTE**

To meet UL conformity requirements of the system where the inverter is installed, use a "UL R/C" or "UL Listed" lug to connect the inverter to the earthing system. Use a loop lug fitting the earth screw and having the same cross-section as the earth cable being used.

**Protective earthing conductor cross-section (refer to EN 61800-5-1):**

| Cross-sectional area of phase conductors of the inverter ($mm^2$) | Minimum cross-sectional area of the corresponding protective earthing conductor ($mm^2$) |
|---|---|
| $S \leq 10$ | 10 (*) |
| $10 < S \leq 16$ | S (*) |
| $16 < S \leq 35$ | 16 |
| $35 < S$ | S/2 |

**NOTE**

The values in the table above are valid only if the protective earthing conductor is made of the same metal as the phase conductors.
If this is not so, the cross-sectional area of the protective earthing conductor shall be determined in a manner which produces a conductance equivalent to that which results from the application of the table above.

**NOTE (*)**

In any case a cross-section of the protective earthing conductor of at least 10 $mm^2$ Cu or 16 $mm^2$ Al is required to maintain safety in case of damage to or disconnection of the protective earthing conductor (refer to EN 61800-5-1 about Touch current).

# 3. USING THE DISPLAY/KEYPAD

## 3.1. Overview

This section covers navigation in the display/keypad.

For details about particular settings of the keypad (contrast, backlight, etc.), please refer to the section concerning the display/keypad in the Sinus Penta's **Installation Instructions** manual, whilst for details regarding custom navigation for the root page, the measures in the Keypad page and the Root page and the PID custom unit of measure, please refer to the DISPLAY/KEYPAD MENU in the Sinus Penta's **Programming Instructions** manual.

## 3.2. Menu Tree

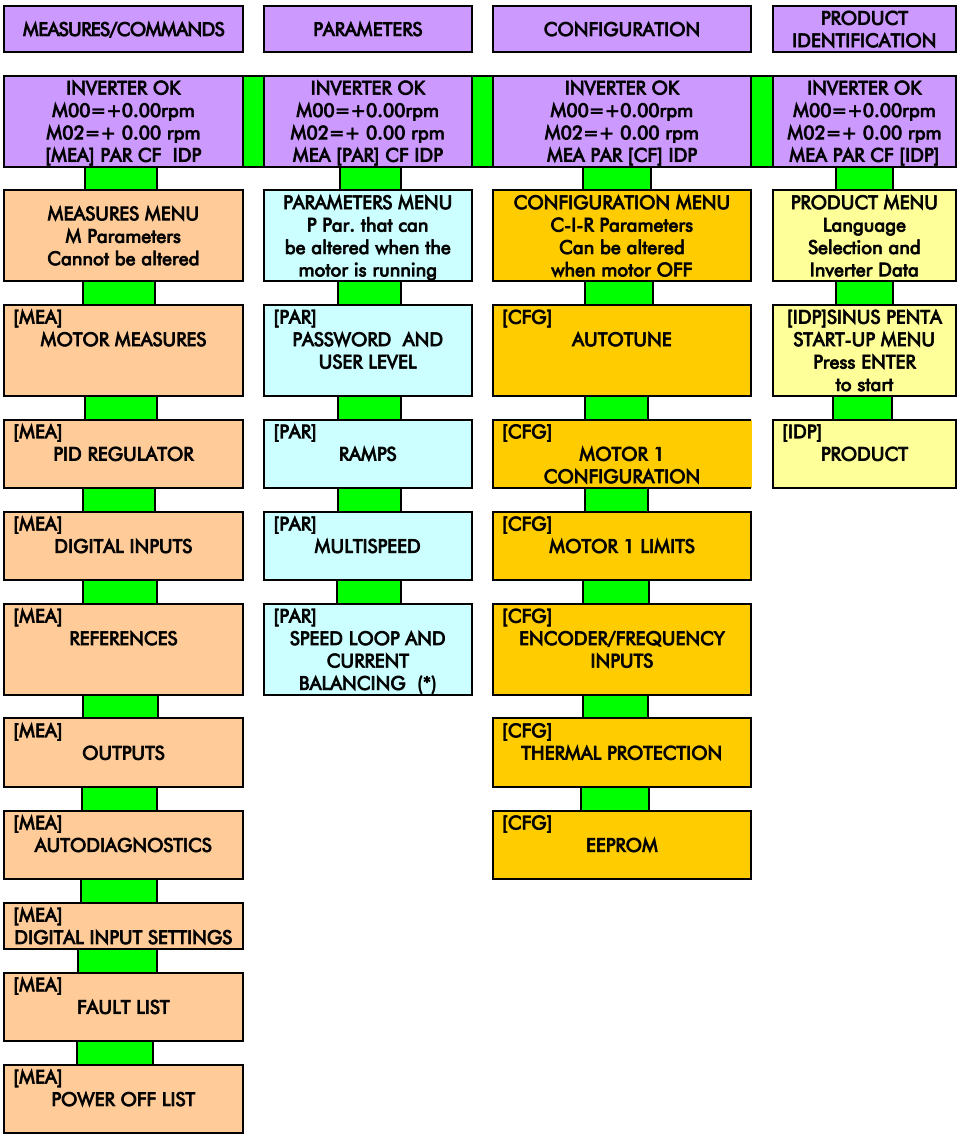
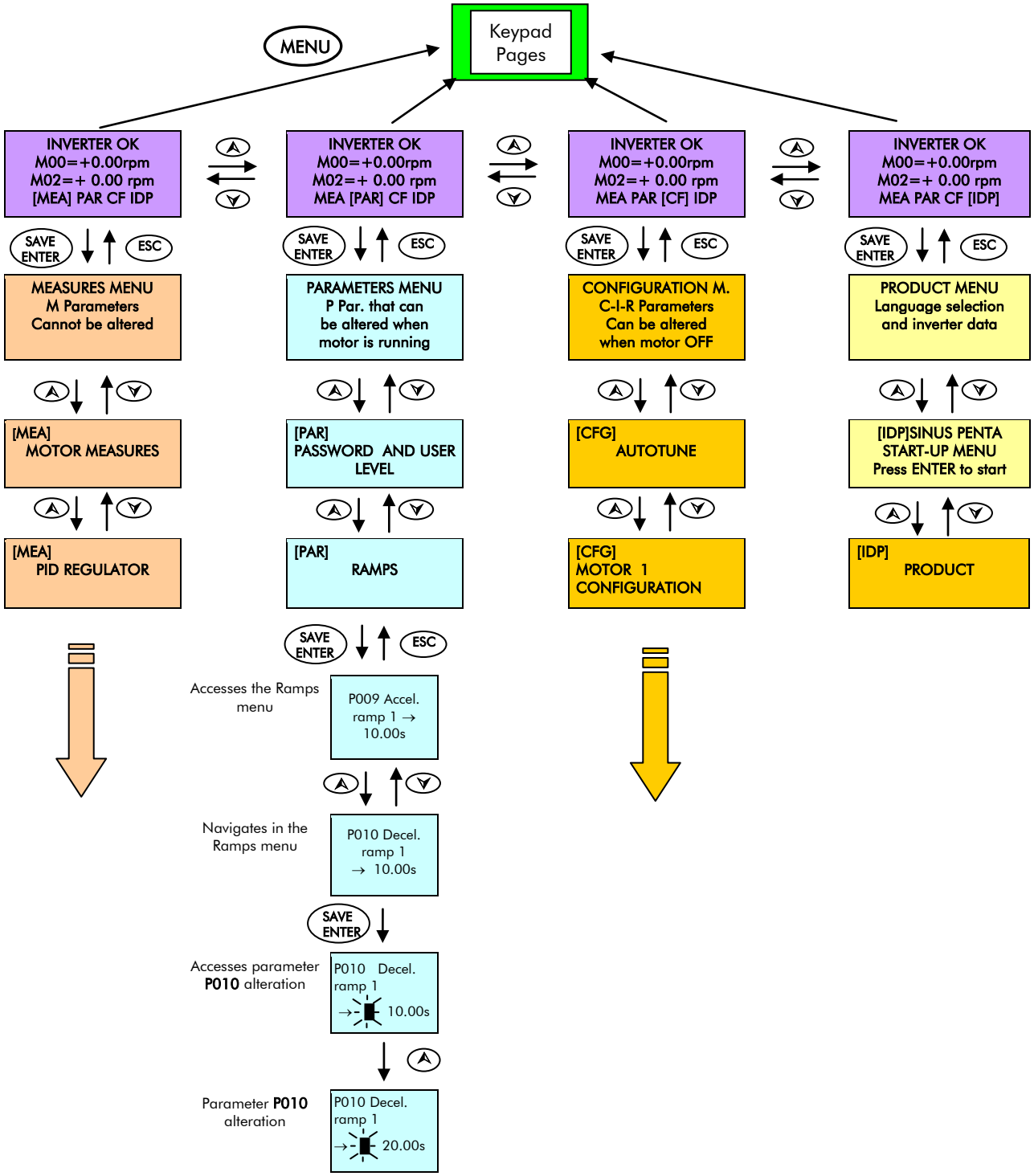

MEASURES/COMMANDS
PARAMETERS
CONFIGURATION
PRODUCT IDENTIFICATION
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm [MEA] PAR CF IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA [PAR] CF IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR [CF] IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR CF [IDP]
MEASURES MENU M Parameters Cannot be altered
PARAMETERS MENU P Par. that can be altered when the motor is running
CONFIGURATION MENU C-I-R Parameters Can be altered when motor OFF
PRODUCT MENU Language Selection and Inverter Data
[MEA] MOTOR MEASURES
[PAR] PASSWORD AND USER LEVEL
[CFG] AUTOTUNE
[IDP]SINUS PENTA START-UP MENU Press ENTER to start
[MEA] PID REGULATOR
[PAR] RAMPS
[CFG] MOTOR 1 CONFIGURATION
[IDP] PRODUCT
[MEA] DIGITAL INPUTS
[PAR] MULTISPEED
[CFG] MOTOR 1 LIMITS
[MEA] REFERENCES
[PAR] SPEED LOOP AND CURRENT BALANCING (*)
[CFG] ENCODER/FREQUENCY INPUTS
[MEA] OUTPUTS
[CFG] THERMAL PROTECTION
[MEA] AUTODIAGNOSTICS
[CFG] EEPROM
[MEA] DIGITAL INPUT SETTINGS
[MEA] FAULT LIST
[MEA] POWER OFF LIST

Figure 7: Menu Tree.

(*) Available for VTC and FOC controls only.

## 3.3. Navigation


MENU
Keypad Pages
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm [MEA] PAR CF IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA [PAR] CF IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR [CF] IDP
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR CF [IDP]
SAVE ENTER
ESC
MEASURES MENU M Parameters Cannot be altered
PARAMETERS MENU P Par. that can be altered when motor is running
CONFIGURATION M. C-I-R Parameters Can be altered when motor OFF
PRODUCT MENU Language selection and inverter data
[MEA] MOTOR MEASURES
[PAR] PASSWORD AND USER LEVEL
[CFG] AUTOTUNE
[IDP]SINUS PENTA START-UP MENU Press ENTER to start
[MEA] PID REGULATOR
[PAR] RAMPS
[CFG] MOTOR 1 CONFIGURATION
[IDP] PRODUCT
Accesses the Ramps menu
P009 Accel. ramp 1 → 10.00s
Navigates in the Ramps menu
P010 Decel. ramp 1 → 10.00s
Accesses parameter P010 alteration
P010 Decel. ramp 1 10.00s
Parameter P010 alteration
P010 Decel. ramp 1 20.00s

If the **ESC** key is pressed to quit, the new parameter value will be acknowledged but not saved to non-volatile memory, and will therefore be lost at power off. Press **SAVE/ENTER** to confirm parameter alteration.

Figure 8: Navigation example.

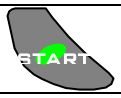
## 3.4. Function Keys

Press the **SAVE/ENTER** key for parameter alteration; when a flashing cursor appears, press ▲ and ▼ to change the parameter value. Do one of the following to quit the editing mode:

**Press ESC** → the parameter value used by the drive is altered and is maintained until the drive is shut off.

**Press SAVE/ENTER** → the parameter value is stored to non-volatile memory and is not deleted when the drive is shut off.

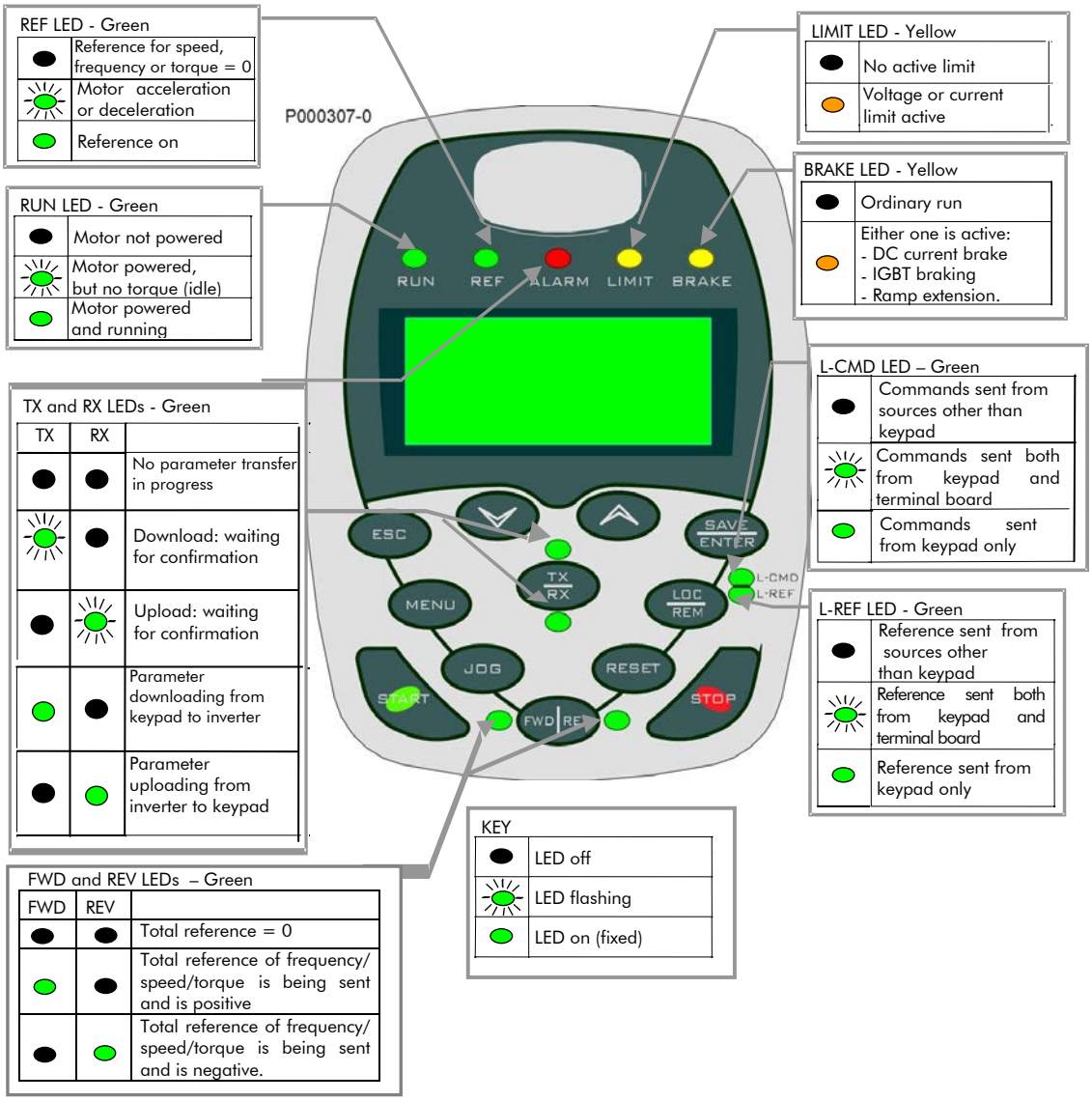
Input values (**Ixxx**) cannot be saved to non-volatile memory; inputs are automatically set to their default values.

| Key | Functions |
|---|---|
| | Quits menus and sub-menus and confirms a new parameter value (when the editing mode is activated, the cursor starts flashing), which is not saved to non-volatile memory (the value is lost when the inverter is turned off). If the Operator mode is set up and the keypad is locked on the Keypad page, press ESC for at least 5 s to restart navigation. |
| | Down arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in descending order. While programming, it decrements the parameter value.<br>Hold it down along with the increment key ^ to access the next menu. |
| | Up arrow; scrolls through the menus and submenus, the pages in a submenu or the parameters in ascending order. While programming, it increments the parameter value. |
| | Accesses menus and submenus. In programming mode (cursor flashing) this key saves to non-volatile memory (EEPROM) the value of the parameter being altered. This prevents any parameter modification from being cleared in case of mains loss.<br>If pressed when the Keypad page is displayed, the SAVE/ENTER key allows displaying the "Keypad Help" page, where the variables viewed in the previous page are detailed. |
| | If pressed more than once, it scrolls through the menus: start page → access page for parameter alteration → ID SW page → keypad → start page, and so on. |
| | Enters the pages for the parameter DOWNLOAD from the keypad to the inverter (TX) or allows parameter UPLOAD from the inverter to the keypad (RX); if pressed more than once, the **TX\|RX** key allows selecting either operating mode. The active selection is highlighted by the page displayed; the relevant TX or RX LED starts flashing.<br>To confirm Upload/Download, press the Save/Enter key when the wanted selection is active. |
| | If pressed once, reference and commands are forced via keypad; press it again to return to the prior configuration or to change the active reference in the Keypad page depending on the preset type of Keypad page (see the Display menu in the SINUS PENTA's Programming Instruction manual). |
| | Resets the alarm tripped once the cause responsible for the alarm has disappeared. Press it for 8 seconds to reset the control board, thus allowing the microprocessors to be reinitialized and to activate R parameters with no need to shut off the inverter. |
|  | If enabled, it starts the motor (at least one of the command sources is represented by the keypad). |
| | If enabled, it stops the motor (at least one of the command sources is represented by the keypad). |
| | The Jog key is active only when at least one of the command sources is represented by the keypad; if depressed, it enters the Jog reference set in the relevant parameter. |
| | If enabled (at least one of the command sources is represented by the keypad), it reverses the sign of the overall reference. Press this key again to change the reference sign. |

## 3.5. Indicator LEDs in the Display/Keypad

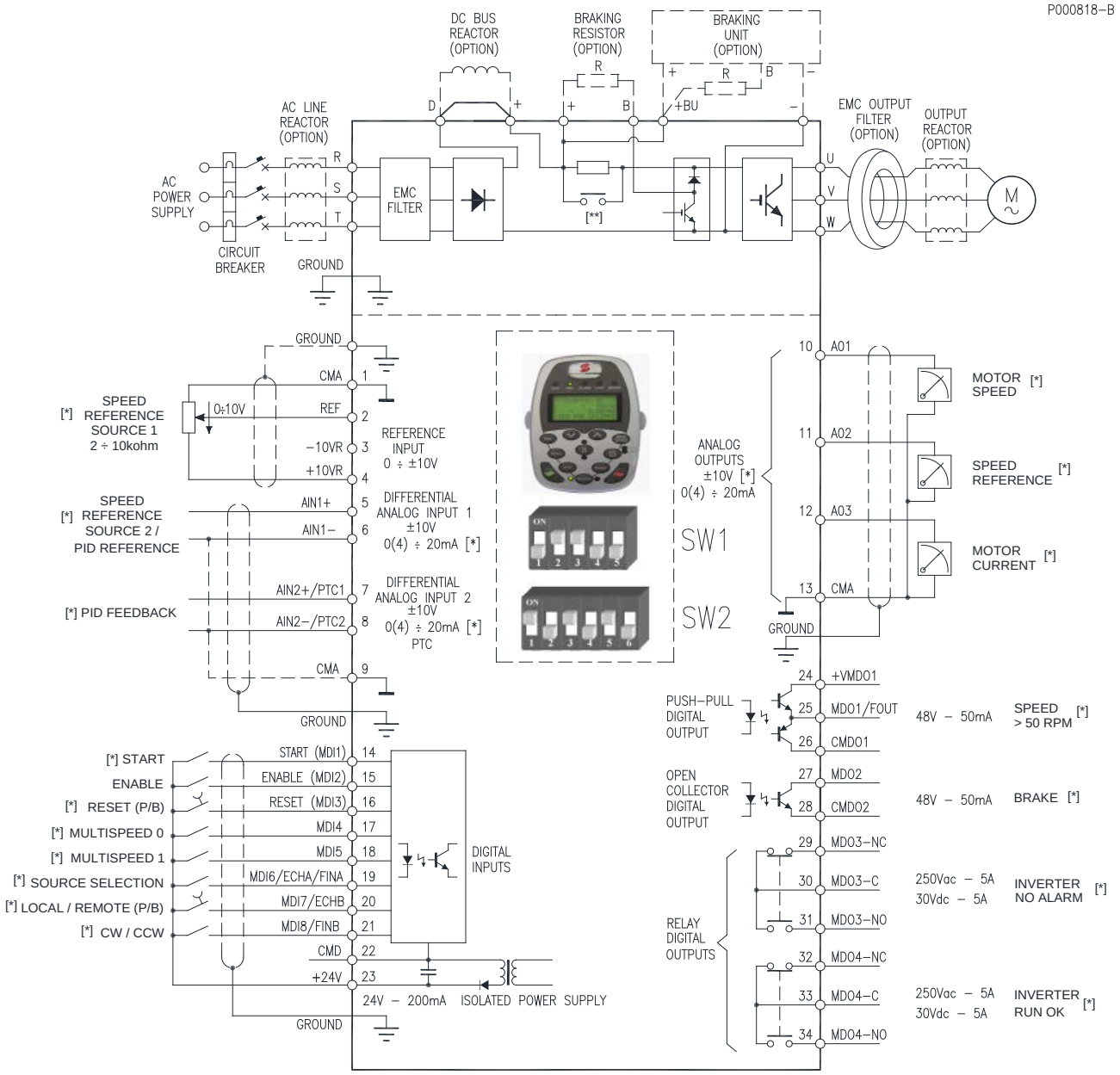
Eleven LEDs are located on the keypad, along with a 4-line, 16-character LCD display, a buzzer and 12 function keys. The display shows parameter values, diagnostic messages and the variables processed by the Penta drive.

The figure below shows the location of the signal LEDs and their functionality.



# 4. WIRING

## 4.1. Wiring Diagram




[*] FACTORY DEFAULTS

[**] PRECHARGE CIRCUIT (SEE BELOW)

Figure 9: Wiring Diagram.

**CAUTION**

In case of fuse line protection, always install the fuse failure detection device, that disables the drive, to avoid single-phase operation of the equipment.

**NOTE**

The wiring diagram relates to factory-setting. Please refer to the Power Terminals / Bars.

**NOTE**

See the REACTORS section in the standard Sinus Penta's **Installation Instructions** manual for any information on accessories and optional reactors. When ordering Sinus Penta S15, S20 and S30, please state if reactors are to be installed on the equipment.

**[*]**

**NOTE**

Factory settings can be changed by changing the configuration of the DIP switches and/or by changing the parameters pertaining to the terminals concerned (see Sinus Penta's **Programming Instructions** manual).

**CAUTION**

When no DC reactor is used, terminals **D** and **+** must be short-circuited (factory setting).

**[**]**

**CAUTION**

Please contact TECO if DC current is to be supplied to Sinus Pentas S41, S42, S51, S52, S60, S64, S74, S84, as no precharge circuit in the DC-bus capacitors is provided.

**CAUTION**

For S60 inverters only: if the supply voltage is other than 500Vac, the wiring of the internal auxiliary transformer must be changed accordingly.

# 5. ALARMS AND WARNINGS

CAUTION

If a protection trips or the drive enters the emergency mode, the drive is locked and the motor idles!

## 5.1. What Happens when a Protective Device Trips

NOTE

Before operating the drive in emergency conditions, carefully read this section and the following section, **What To Do When an Alarm Trips**.

The drive alarms are detailed below.

When a protection / alarm trips:

1) the **ALARM** LED on the keypad comes on;
2) the page displayed on the keypad is the root page of the **FAULT LIST**;
3) the **FAULT LIST** is refreshed;

In factory-setting, when the drive is switched on after an alarm has tripped—which has not been reset—it is kept in emergency condition.
**If the drive is in emergency mode when switched on, this could be due to an alarm tripped before the drive was reset.**
To avoid storing the alarms tripped before the drive is switched off, set parameter **C257** in the **Autoreset Menu**.
The drive stores the moment when an alarm trips to the **FAULT LIST** (supply–time and operation–time). The drive status when the alarm tripped and some measures sampled when the alarm tripped are also stored to the Fault List.
The readout and storage of the fault list can be very useful to detect the cause responsible for the alarm and its possible solution (see also the Fault List Menu/Power Off List Menu in the Sinus Penta's **Programming Instructions** manual).

NOTE

Alarms **A001** to **A039** relate to the main microcontroller (DSP Motorola) of control board, which detected a fault on the control board itself. No fault list is available for Alarms **A001** to **A039** and no Reset command can be sent via serial link; alarms can be reset through the **RESET** terminal on the terminal board or the **RESET** key on the keypad. No software for the keypad interface is available; the drive parameters and measures cannot be accessed via serial link.
Avoid resetting alarms **A033** and **A039**, as they trip when the flash memory is not provided with its correct software. Alarms **A033** and **A039** can be reset only when proper software is downloaded for the drive flash memory.

CAUTION

Before resetting any alarm, deactivate the **ENABLE** signal on terminal **MDI2** to disable the drive and prevent the connected motor from running at uncontrolled speed.

## 5.2. What To Do when an Alarm Trips

CAUTION

Before resetting any alarm, disable the **ENABLE** signal on terminal **MDI2** to disable the drive and to prevent the connected motor from running at uncontrolled speed.

Proceed as follows:

1. Disable the **ENABLE** signal on terminal **MDI2** to disable the drive and to lock the motor, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the drive, this will start only if the **ENABLE** contact is open and closed.
2. If the motor is idling, wait until it stops.

Check the **FAULT LIST** carefully for any information about the alarm tripped, in order to find the cause responsible for the alarm and its possible solutions.
Any information stored to the FAULT LIST is also required when contacting TECO's Customer Service.

3. In the following sections, find the alarm code and follow the instructions given.
4. Solve any external problems that may have been responsible for the protection trip.
5. If the alarm tripped due to the entry of wrong parameter values, set new correct values and save them.
6. Reset the alarm.
7. If the alarm condition persists, please contact TECO's Customer Service.

A **RESET** command must be sent to reset the alarms tripped. Do one of the following:

- Enable the **RESET** signal in **MDI3** terminal in the hardware terminal board;
- Press the **RESET** key on the keypad.

## 5.3. Alarm Code List

| Alarm | Alarm Message | Description | What to do |
|---|---|---|---|
| A001 ÷ A032<br>A034 ÷ A038 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A033 | TEXAS VER KO | Incompatible Texas Software Version | 1. Download the correct DSP Texas software version.<br>2. Contact TECO's Customer Service. |
| A039 | FLASH KO | Texas Flash not programmed | |
| A040 | User Fault | Alarm caused by the user | Reset the Penta drive. |
| A041 | PWMA Fault | General hardware fault from IGBT, side A | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A042 | Illegal XMDI in DGI | Illegal configuration of XMDI in the Digital Inputs menu | 1. Check setting in **R023**.<br>2. Check settings in the Digital Inputs menu. |
| A043 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A044 | SW OverCurrent | Software overcurrent | 1. Check drive and motor ratings.<br>2. Check output short circuit.<br>3. Check for disturbance in control signal.<br>4. Set a longer acceleration time.<br>5. Set a longer deceleration time.<br>6. Disconnect motor and change **C010** to 0:IFD. |
| A045 | Bypass Circuit Fault | Precharge By–Pass fault | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A046 | Bypass Connector Fault | Precharge By–Pass connector fault | |
| A047 | UnderVoltage | DC bus voltage lower than Vdc_min | 1. Check supply voltage on terminals R, S, T.<br>2. Check **M030** (Supply voltage) and **M029** (DC bus voltage).<br>3. Check **M030** and **M029** in the Fault List.<br>4. Contact TECO's Customer Service. |
| A048 | OverVoltage | DC bus voltage exceeding Vdc_max | 1. Check supply voltage on terminals R, S, T.<br>2. Check **M030** (Supply voltage) and **M029** (DC bus voltage).<br>3. Check **M030** and **M029** in the Fault List.<br>4. Set a longer deceleration time.<br>5. Add dynamic brake resistor.<br>6. Contact TECO's Customer Service. |
| A049 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A050 | PWMA0 Fault | Hardware Fault from IGBT converter, side A | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A051 | PWMA1 Fault | Hardware overcurrent, side A | 1. Check drive and motor ratings.<br>2. Check output short circuit.<br>3. Check disturbance in control signal.<br>4. Set a longer acceleration time.<br>5. Set a longer deceleration time.<br>6. Disconnect motor and change **C010** to 0:IFD. |
| A052 | Illegal XMDI in DGO | Illegal configuration of XMDI in the Digital Outputs menu | 1. Check setting in **R023**.<br>2. Check settings in the Digital Outputs menu. |
| A053 | PWMA Not ON | Hardware failure, IGBT A power on impossible | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A054 | Option Board not in | Failure in detecting preset option I/O board | 1. Check consistency of parameter **R023.**<br>2. Contact TECO's Customer Service. |
| A055 | PTC Alarm | External PTC tripped | 1. Allow motor to cool.<br>2. Ensure that PTC is correctly connected to AIN2.<br>3. Ensure that SW1 is correctly set up in the control board. |

| Alarm | Alarm Message | Description | What to do |
|---|---|---|---|
| **A057** | Illegal XMDI in MPL | Illegal configuration of XMDI in the Virtual Digital Outputs menu | 1. Check setting in **R023**.<br>2. Check setting in the MPL menu. |
| **A059** | Encoder Fault | Error of motor speed measure | 1. Check if encoder parameters are correct.<br>2. Check if encoders are properly connected and mounted.<br>3. Check if encoder signals are correct. |
| **A060** | NoCurrent Fault | Current is zero in FOC control | 1. Check motor connections U, V, W.<br>2. Check FOC regulator menu setting (**Engineering** user level required).<br>3. Perform a new current regulator autotune.<br>4. Contact TECO's Customer Service. |
| **A061** | Ser WatchDog | Watchdog tripped in serial link 0 (9-pole D connector) | 1. Check serial link 0.<br>2. Make sure that the master sends read/write queries with max. interval between queries lower than preset watchdog operation time.<br>3. Set longer watchdog operation time (**R005**). |
| **A062** | SR1 WatchDog | Watchdog tripped in serial link 1 (RJ45) | 1. Check serial link 1.<br>2. Make sure that the master sends read/write queries with max. interval between queries lower than preset watchdog operation time.<br>3. Set a longer watchdog operation time (**R012**). |
| **A063** | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| **A064** | Mains Loss | No power is supplied from the mains | 1. Check supply voltage on terminals R, S, T.<br>2. Check **M030** (Supply voltage).<br>3. Check **M030** in the Fault List.<br>4. Alarm may be disabled or delayed in Power down menu (**Engineering** user level required). |
| **A065** | AutoTune Fault | Autotune failed | 1. Reset the Penta drive.<br>2. Check parameters in Motor Control Menu and perform a new autotune.<br>3. Contact TECO's Customer Service. |
| **A066** | REF < 4mA | REF Current input (4÷20mA) lower than 4mA | 1. Check setting of SW1 in control board.<br>2. Check if signal cable is properly connected.<br>3. Check the current signal source. |
| **A067** | AIN1 < 4mA | AIN1 Current input (4÷20mA) lower than 4mA | |
| **A068** | AIN2 < 4mA | AIN2 Current input (4÷20mA) lower than 4mA | |
| **A069** | XAIN5 < 4mA | XAIN5 Current input (4÷20mA) lower than 4mA | 1. Check if signal cable is properly connected.<br>2. Check the current signal source. |
| **A070** | Fbs WatchDog | Fieldbus Watchdog tripped | 1. Check fieldbus connection.<br>2. Ensure master sends legal messages with max. time interval lower than preset watchdog time.<br>3. Set longer watchdog times (**R016**) |
| **A071** | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| **A072** | Parm Lost Chk | Parameter download/upload error | 1. Check keypad connection.<br>2. Reset the alarm and repeat Upload/Download. |
| **A073** | Parm Lost 1 COM | Parameter download/upload error | |

| Alarm | Alarm Message | Description | What to do |
|---|---|---|---|
| A074 | Inverter Overheated | Drive thermal protection tripped | 1. Check drive output current (M026) during normal operation.<br>2. Check mechanical load of connected motor (locked shaft/overload). |
| A075 | Motor Overheated | Motor thermal protection tripped | 1. Check mechanical conditions and load.<br>2. Check parameters C265 and C267. |
| A076 | Speed Alarm | Motor speed too high | 1. Check if C031 is compatible with the connected motor.<br>2. Check the torque reference in Slave mode (Advanced user level required). |
| A078 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A079 | FOC No Encoder | FOC control but Encoder not enabled | Set correct encoder parameters for FOC control. |
| A080 | Tracking Error | Encoder speed tracking error | 1. Set param. C192, C193 correctly.<br>2. Check torque limit value.<br>3. Check mechanical load.<br>4. Check encoder operation (Engineering user level required). |
| A081 | KeyPad WatchDog | Communication watchdog via keypad | 1. Check keypad connection.<br>2. Check settings for RJ45 serial link. |
| A082 | Illegal Encoder Cfg | Functions programmed for MDI6 and MDI7 or Encoder B selected but no encoder board detected | 1. Check setting of C189.<br>2. Check settings for MDI6 and MDI7.<br>3. Check encoder board, if used (Advanced user level required). |
| A083 | External Alarm 1 | External alarm 1 | Check external signal in allocated MDI. |
| A084 | External Alarm 2 | External alarm 2 | |
| A085 | External Alarm 3 | External alarm 3 | |
| A086 | XAIN5 > 20mA | XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA | 1. Check if signal cable is properly connected.<br>2. Check the current signal source. |
| A087 | ±15V LOSS | ± 15V Loss | 1. Reset the alarm: send a RESET command.<br>2. Contact TECO's Customer Service. |
| A088 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A089 | Parm Lost 2 COM | Parameter download/upload error | 1. Check keypad connection.<br>2. Reset the alarm and repeat Upload/Download. |
| A090 | Parm Lost 3 COM | Parameter download/upload error | |
| A091 | Braking Resistor Overload | Overvoltage with braking resistance enabled due to continuous operation longer than the time set in C211 | 1. Resest the Penta drive.<br>2. Increase resistor rating and settings for C211-C212 (Engineering user level required). |
| A092 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |
| A093 | Bypass Circuit Open | By-Pass relay open | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A094 | Heatsink Overheated | IGBT heatsink temperature too high | 1. Check ambient temperature.<br>2. Check motor current.<br>3. Decrease carrier frequency (C001-C002). (Engineering user level required). |
| A095 | Illegal Drive Profile Board | Incorrect configuration of Drive Profile board | 1. Make sure that the Drive Profile board is correctly configured for the Sinus Penta drive.<br>2. Replace the Drive Profile board. |
| A096 | Fan Fault | Fault of the cooling fans | Replace fans. |
| A097 | Motor Not Connected | Motor not wired | 1. Check connections to U, V, W.<br>2. Check motor parameters & perform new autotune for VTC & FOC. |
| A098 | Illegal Motor Selected | Illegal motor selected via MDI | 1. Check setting in C009.<br>2. Check C173-C174 and MDI status (Engineering user level required). |

| Alarm | Alarm Message | Description | What to do |
|---|---|---|---|
| A099 | 2nd Sensor Fault | Fault of fan sensor 2 | 1. Reset the Penta drive.<br>2. Contact TECO's Customer Service. |
| A100 | MDI6 Illegal Configuration | Function programmed for MDI6 along with frequency input A | Check configuration of MDI6 and setting in C189. |
| A101 | MDI8 Illegal Configuration | Function programmed for MDI8 along with frequency input B | |
| A102 | REF>20mA | REF Current input (4÷20mA or 0÷20mA) greater than 20mA | 1. Check setting of SW1 in control board.<br>2. Check the current signal source. |
| A103 | AIN1>20mA | AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA | |
| A104 | AIN2>20mA | AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA | |
| A105 | PT100 Channel 1 Fault | Hardware address out of measure range of the drive | 1. Check setting of SW1 in ES847 (optional board).<br>2. Check the current signal source. |
| A106 | PT100 Channel 2 Fault | Hardware address out of measure range of the drive | |
| A107 | PT100 Channel 3 Fault | Hardware address out of measure range of the drive | |
| A108 | PT100 Channel 4 Fault | Hardware address out of measure range of the drive | |
| A109 | Amb.Overtemp. | Ambient overtemperature | 1. Open the cabinet and check its conditions. Also check measure M062.<br>2. Reset the Penta drive.<br>3. Contact TECO's Customer Service. |
| A110 ÷ A127 | … | *Control board failure* | *1. Reset the Penta drive.*<br>*2. Contact TECO's Customer Service.* |

Table 1: Alarm Code List.

## 5.4. Warnings

**Warning** messages are displayed on the display/keypad. They are flashing messages that usually appear in line 1 or 2 on the display.

**NOTE** Warnings are neither protections nor alarms, and are not stored to the Fault list.

| Warning | Message | Description |
|---|---|---|
| W03 | SEARCHING… | The user interface is searching the data of the next page to display. |
| W04 | DATA READ KO | Software warnings concerning data **reading**. |
| W06 | HOME SAVED | The page displayed has been saved as the home page displayed at power on. |
| W07 | DOWNLOADING | The keypad is **writing** to the drive the WORK zone parameters saved to its own flash memory. |
| W08 | UPLOADING | The keypad is **reading** from the drive the WORK zone parameters that will be saved to its own flash memory. |
| W09 | DOWNLOAD OK | Parameters were successfully downloaded (**written**) from the keypad to the drive. |
| W11 | UPLOAD OK | Parameters were successfully uploaded (**read**) from the drive to the keypad. |
| W12 | UPLOAD KO | The keypad interrupted parameter upload to the drive.<br>Parameter **reading** has failed. |
| W13 | NO DOWNLOAD | A Download procedure was queried, but no parameter is saved to the flash memory. |
| W16 | PLEASE WAIT… | Wait until the system completes the operation required. |
| W17 | SAVE IMPOSSIBLE | Parameter save is not allowed. |
| W18 | PARAMETERS LOST | The keypad interrupted parameter download to the drive. Parameter **writing** has failed. As a result, not all parameters have been updated (parameter inconsistency). |
| W19 | NO PARAMETERS LOAD | UPLOAD impossible. |
| W20 | NOT NOW | The required function is not available at the moment. |
| W21 | CONTROL ON | The required function is inhibited because the drive is running. |
| W23 | DOWNLOAD VER. KO | Download failed because parameters saved to keypad memory relate to a SW version or product ID incompatible with the drive SW version or product ID. |
| W24 | VERIFY DATA | Download preliminary operation underway, the system is checking the integrity and compatibility of the parameters saved in the keypad memory. |
| W28 | OPEN START | Open and close the **START** (MDI1) signal to start the drive. |
| W31 | ENCODER OK | Encoder tuning procedure finished: the encoder is correctly connected. |
| W32 | OPEN ENABLE | Open and close the **ENABLE** (MDI2) signal to enable the drive. |
| W33 | WRITE IMPOSSIBLE | Writing procedure impossible. |
| W34 | ILLEGAL DATA | Illegal value entered, operation failed. |
| W35 | NO WRITE CONTROL | Writing procedure impossible because Control is active and the drive is running. |
| W36 | ILLEGAL ADDRESS | Illegal address entered, operation failed. |
| W37 | ENABLE LOCKED | The drive is disabled and does not acknowledge the **ENABLE** command because it is writing a "C" parameter.<br> **CAUTION The drive will start up as soon as writing is over!!!** |
| W38 | LOCKED | Editing mode cannot be accessed because parameter modification is disabled: **P000** is different from **P002**. |

| Warning | Message | Description |
|---|---|---|
| W39 | KEYPAD DISABLED | The editing mode cannot be accessed because the keypad is disabled. |
| W40 | FAN FAULT | Fan locked or disconnected or faulty. |
| W41 | SW VERSION KO | Download impossible because of different SW Versions. |
| W42 | IDP KO | Download impossible because of different IDPs (Identification Products). |
| W43 | PIN KO | Download impossible because of different PINs (Part Identification Numbers). |
| W44 | CURRENT CLASS KO | Download impossible because of different current classes. |
| W45 | VOLTAGE CLASS KO | Download impossible because of different voltage classes. |
| W46 | DOWNLOAD KO | Download impossible (generic cause). |
| W48 | OT Time over | The preset threshold for the drive Operation Time has been exceeded. |
| W49 | ST Time over | The preset threshold for the drive Supply Time has been exceeded. |
| W50 | NTC Fault | NTC sensor for heatsink temperature disconnected or faulty |

Table 2: Warning list.

## 5.5. State List

| Number | State | Description |
|---|---|---|
| 0 | ALARM!!! | Alarm tripped |
| 1 | START UP | The drive is starting up |
| 2 | MAINS LOSS | Mains loss |
| 3 | TUNING | The drive is tuning |
| 4 | SPEED SEARCHING | Searching for motor speed |
| 5 | DCB at START | DC Braking at start |
| 6 | DCB at STOP | DC Braking at stop |
| 7 | DCB HOLDING | DC current for Hold function |
| 8 | DCB MANUAL | Manual DC Braking |
| 9 | LIMIT IN ACCEL. | Current/torque limit while accelerating |
| 10 | LIMIT IN DECEL. | Current/torque limit while decelerating |
| 11 | LIMIT IN CONSTANT RPM | Current/torque limit at constant rpm |
| 12 | BRAKING | Braking module startup or deceleration ramp extension |
| 13 | CONSTANT RUN | Drive running at speed set point |
| 14 | IN ACCELERATION | Drive running with motor in acceleration stage |
| 15 | IN DECELERATION | Drive running with motor in deceleration stage |
| 16 | INVERTER OK | Drive on Stand-by with no alarms tripped |
| 17 | FLUXING | Motor fluxing stage |
| 18 | MOTOR FLUXED | Motor fluxed |
| 19 | FIRE MODE RUN | Constant rpm in Fire Mode |
| 20 | FIRE MODE ACCEL. | Acceleration in Fire Mode |
| 21 | FIRE MODE DECEL. | Deceleration in Fire Mode |
| 22 | INVERTER OK* | Drive on Stand-by with no alarms tripped, but void warranty due to alarm trip in Fire Mode |
| 25 | SPARE | Board in Spare mode |
| 27 | WAIT NO ENABLE | Waiting for **ENABLE** command opening |
| 28 | WAIT NO START | Waiting for **START** command opening |
| 29 | PIDOUT min DISAB | Drive disabled due to PID output < Min. |
| 30 | REF min DISAB. | Drive disabled due to REF < Min. |
| 31 | IFD WAIT REF. | Drive enabled with IFD control<br>waiting for reference in order to start |
| 32 | IFD WAIT START | Drive enabled with IFD control<br>waiting for START in order to start |
| 33 | DISABLE NO START | When fluxing, the RUN command was not given within the max. time set in **C183**. The drive is kept disabled until the RUN command is given. |

**Table 3: State List.**